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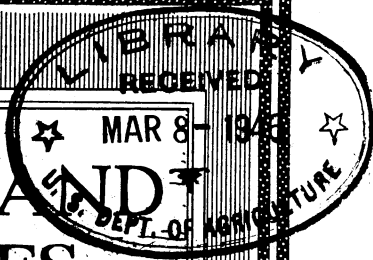
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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1652

DISEASES AND PARASITES *of* POULTRY



CHICKENS, turkeys, ducks, geese, pigeons, and other species of poultry are susceptible to many diseases, some of which affect only part of a flock whereas others are highly infectious and may spread through the flock and may also be carried by one means or another to neighboring flocks, producing extensive outbreaks, or epizootics.

Nutrition has been shown to have an important influence on health and productiveness of poultry. The lack of certain vitamins, minerals, or other food elements is likely to establish fairly definite disease symptoms. On the other hand, an excess of some food substances may also be detrimental to the birds' well-being. Likewise, roomy, comfortable, and well-ventilated living quarters are essential to the health and productivity of the flock.

Poultry are also infested by numerous kinds of parasites, some of which live on the surface of the body and others internally, especially in the crop, stomach, and intestines. These parasites may seriously affect the health of the birds by preventing their nourishment and by causing irritation and inflammation of the parts which they attack.

Certain diseases respond favorably to treatment. Others resist all efforts at treatment and cause heavy losses.

Preventive measures properly applied offer the surest means of controlling diseases of domesticated birds.

The purpose of this bulletin is to inform the poultry owner as to the characteristics of the various diseases and infestations in order that he may intelligently use the most approved methods of combating them. However, it is in no sense intended to replace the valuable services and advice of the trained veterinarian, which, if available, should by all means be obtained.

This bulletin is a revision of and supersedes Farmers' Bulletin 1337, Diseases of Poultry.

DISEASES AND PARASITES OF POULTRY¹

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¹ This is a revision of former editions by John S. Buckley (deceased), Hubert Bunyea, and Eloise B. Cram.

² Acknowledgement is made of material supplied by Walter J. Hall concerning fowl paralysis, George W. Stiles on carbon-monoxide poisoning, and Harry W. Titus on nutritional diseases, all of the Bureau of Animal Industry. F. C. Bishopp, of the Bureau of Entomology and Plant Quarantine, furnished the information relating to insects, mites, and ticks.

NATURE AND IMPORTANCE OF POULTRY DISEASES

DOMESTIC BIRDS are subject to a considerable number of diseases, some of which spread rapidly through the flock and cause high mortality. They may also be infested by various kinds of parasites, some of which live on the surface of the body and others in various passages or organs within the body. These parasites are injurious because they take part of the nourishment which should be used by the bird to put on flesh or to produce eggs, and also because by their movements and other activity they cause irritation and inflammation of the parts they attack.

The contagious diseases which are caused by germs and viruses and the weakness and loss of flesh caused by the larger parasites just mentioned are the most important conditions which the poultryman has to consider in the endeavor to keep his birds healthy. These germs, viruses, and parasites, should be kept out of the flock by suitable preventive measures, because disease may be avoided much more easily and cheaply than it can be cured. The aim in studying the diseases of poultry is, therefore, to learn how to prevent the diseases as well as how to control them once they become established.

DISEASE PREVENTION

To prevent diseases, we need to understand something about them. Some diseases are caused by infection; others result from faults of nutrition; and still others are traceable to the general conditions surrounding the flock.³

The first rule of health is sanitation. The observance of this rule comprises the following points: (1) Quarantining of new stock until it is known to be healthy; (2) protecting the flock from access to polluted drinking water, spoiled or infected feeds, or contaminated grounds; (3) burying, burning, or otherwise making proper disposal of diseased carcasses; (4) thoroughly cleaning and disinfecting premises contaminated by disease; (5) protecting the flock from diseases and parasites carried by free-flying birds; and (6) preventing persons who own unhealthy chickens from entering the poultry yards or houses.

Proper nutrition is the second rule of health. Some diseases are caused by a ration lacking certain elements, while others are due to excessive feeding of some feeds. Rickets, nutritional roup, polyneuritis and perosis are deficiency diseases, whereas obesity and gout are attributed to the feeding of diets that contain excessive quantities of certain substances. A balanced ration with meat scrap and shell or bone, a regular allowance of green feeds, and clean water, should contain all the vital elements of nutrition ordinarily required by birds.

The third rule of health is good surroundings; that is, roomy, comfortable, well-ventilated poultry houses, free from drafts or dampness, and with ample provision for exercise and suitable exposure to the direct rays of the sun.

Large flocks should be divided into smaller units for convenience in care and feeding and as an aid to disease prevention. Birds of various ages and of different species should be kept separate.

³ Additional information on the correct feeding and housing of poultry is contained respectively in Farmers' Bulletin 1841, The Feeding of Chickens, and Farmers' Bulletin 1554, Poultry Houses and Fixtures, which may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., price, 5 cents each.

DISEASE CONTROL AND ERADICATION

The extensive use, in recent years, of artificial and wholesale methods of incubation, housing, and feeding has increased the opportunity for disease development and transmission at an alarming rate so that disease has become one of the greatest barriers to success with poultry. New and baffling diseases are springing up, and their diagnosis and control are essential.

Normal, healthy chickens do not require drugs of any kind. When an outbreak of disease occurs in a flock the first procedure is to get an accurate diagnosis. This can be done best by the local veterinarian, but if no practicing veterinarian is available, it is a good plan to communicate with the State agricultural experiment station. If the disease proves to be a contagious one, the next step is to remove the sick birds from the flock. Remedies and curative treatments are useless in most of the devastating contagious diseases, and the treatment of sick birds increases the opportunity for the spread of the disease to the rest of the flock. The proper handling of contagious diseases consists in sanitation, preventive treatment, and eradication rather than cure.

Diagnostic tests for pullorum disease and tuberculosis, as well as fowl pox vaccination and laryngotracheitis vaccination, should be conducted by a person experienced in poultry diseases.

DISINFECTANTS AND THEIR APPLICATION ⁴

Good disinfectants destroy the germs of contagious diseases, and in some cases, external parasites such as lice and mites. Since the germicidal power of disinfecting solutions is rapidly spent by contact with organic matter it is always important to give special attention to the cleaning of the premises, the removal of all litter, contaminated soil, and manure, before applying the disinfecting solution. The disinfectants should be thoroughly applied to the interior of the houses, worked into all the cracks and crevices, spread over the ceiling and the floor, the roosts, dropping boards, nest boxes, and feeding and drinking vessels. Merely sprinkling the germicide here and there is of little value. Disinfectants are most easily applied to the walls and ceilings with a spray pump or with a brush. As it is difficult to keep them from coming into contact with the face and hands, the mixtures least harmful to persons should generally be used.

In case of an actual outbreak of virulent disease it is advisable to use for disinfecting purposes a whitewash made by dissolving 1 pound of commercial lye (containing 94 percent of sodium hydroxide) and 2½ pounds of water-slaked lime in 5½ gallons of water. If the solution is not used at once, it should be tightly covered to prevent deterioration. This solution is cheap, odorless, and destructive to almost all kinds of disease germs. On prolonged contact, however, it may be injurious to painted or varnished surfaces, and to some fabrics. It is corrosive to aluminum, but relatively harmless to the metallic fixtures ordinarily found about chicken houses, and to wooden construction or equipment. The poultry yard may be disinfected by wetting it thoroughly; use from ½ to 1 gallon of the solution per square yard of

⁴ Additional information on the subject is contained in Farmers' Bulletin 926, Some Common Disinfectants, and Farmers' Bulletin 954, The Disinfection of Stables, which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., price 5 cents each.

soil surface, depending upon the absorbent quality of the ground. It is essential, however, that all refuse matter be removed from the surface and burned or buried before poultry runs are disinfected.

The above-mentioned disinfectant solution has been found through experimentation to be ineffective against the germs of tuberculosis. For combating that infection, the chicken houses, enclosed runs, and all eating, drinking, and other utensils should be thoroughly cleaned and disinfected with a strong solution of such germicides as carbolic acid or compound solution of cresol. Carbolic acid may be used in 5-percent solution and compound solution of cresol in 3-percent solution.

Kerosene emulsion is frequently used to destroy mites. To make the emulsion, shave half a pound of hard laundry soap into half a gallon of soft water and boil the mixture until all the soap is dissolved; then remove it to a safe distance from the fire and stir into it at once, while still hot, 2 gallons of kerosene. This makes a thick, creamy emulsion or stock mixture. When it is to be used for killing mites in the houses, 1 quart of this emulsion is mixed with 10 quarts of water.

The carbolineums advised for control of the common chicken mite and fowl tick are wood preservatives derived from coal tar. They should consist of pure anthracene oil. Creosote oil, advised as a spray for killing fleas, is also a coal-tar product used as a wood preservative. It should contain 10 to 15 percent of tar acids. These materials, especially creosote oil, are caustic and will stain; therefore, they should be used with care and should be allowed to dry into the wood thoroughly before fowls are allowed to enter the treated building:

See last page for precautions in handling disinfectants.

A further means of freeing premises from infection by most germs and parasites is to keep them free of fowls for several months, or a year if possible. Most disease organisms are destroyed if directly exposed to the sun's rays for a short time, and by this means fields and yards are eventually disinfected to a large extent. There are many dark or covered places not reached by the direct rays of the sun, however, and in such spots germs may survive for several months. In the case of highly resistant forms of infection, such as oöcysts of coccidia, disinfection in addition to vacating the premises is a desirable safeguard. It is advisable to place new stock on ground which has not been occupied by poultry for a year or more.

NUTRITIONAL DISEASES

NUTRITIONAL ROUP (VITAMIN A DEFICIENCY)

Nutritional roup is a disease of chickens and other poultry resembling infectious coryza, but is caused by a deficiency of vitamin A in the diet. It may appear in chickens of any age. The usual symptoms are lameness or a staggering gait, discharge from the nostrils, swelling beneath the eyes, and discharge from the eyes. Examination after death shows swollen follicles in the esophagus, pale kidneys, and, frequently, white accumulations of urates in the kidneys and ureters.

Treatment.—On being supplied with feeds containing vitamin A in sufficient quantities, poultry affected with nutritional roup usually recover. High-grade cod-liver oil is an excellent source of vitamin A. Other good sources are fresh, green feeds, alfalfa leaf meal, raw carrots, corn gluten meal, and yellow corn.

POLYNEURITIS (VITAMIN B₁ DEFICIENCY)

Polyneuritis is a condition that results from consuming a diet deficient in vitamin B₁. It may appear in birds of any age but growing birds are more susceptible than adults. This condition very seldom is observed in practice. The symptoms are loss of appetite, emaciation, general weakness and inability to stand, and spasmodic movements of the head and limbs.

Treatment.—Treatment consists simply in feeding of whole grains and green feed. Since a satisfactory reserve of vitamin B₁ cannot be stored in the body it is important that it constitute a portion of the regular diet.

GIZZARD EROSION

The term gizzard erosion is used in referring to several abnormal conditions of the gizzard lining. In one condition there are one or more patches of threadlike, shallow fissures in the lining; in another there are small holes (sometimes referred to as dry ulcers) that usually contain blood debris; and in still another condition there are a softening and sloughing of portions of the lining. The first two conditions occur much more frequently than the third. The disease is most prevalent in chicks under 6 weeks old. The greatest incidence occurs during the first four days after hatching.

Cause.—The exact cause of gizzard erosion is not known. The most common type of gizzard erosion is preceded by hemorrhages from the capillaries in the submucosa. The reddish-brown spots and patches frequently found in the lining are the results of these hemorrhages.

Treatment.—When a well-balanced diet is fed, the reddish-brown spots disappear, then the patches, and finally the holes. The inclusion of one-tenth to one-half percent of dried ox bile in the diet hastens the disappearance of the erosions. Bile salts have a similar effect. There is some evidence that certain feedstuffs, such as alfalfa leaf meal, alfalfa meal, kale, bran, wheat middlings, or oats when included in the diet, tend to hasten the clearing up of the condition.

GOUT

Gout is caused by the presence of an abnormal quantity of uric acid in the blood, which results in the deposit of urates on the internal organs (visceral gout) or occasionally in the joints (articular gout).

Cause.—The exact cause of the excessive uric acid is not known. However, the presence of an abnormally large quantity of it in the blood and deposits of urates on the internal organs and occasionally in the joints is evidence of interference with the normal excretion of uric acid.

Symptoms.—In articular gout the joints of the feet and wings may be involved with consequent lameness. At first the joints are swollen and painful. The lesions then form into nodular, tumorlike growths which may later burst, discharging a yellowish, turbid material containing urates. The bird remains sitting as much as possible. The general health becomes affected, and emaciation gradually occurs, with weakness and frequently diarrhea.

Visceral gout is apparent on autopsy only. The internal organs and serous membranes are found covered with chalklike deposits, particularly the heart and the inside of the heart sac. The kidneys and ureters are frequently swollen, pale, and engorged with urates. The course of the disease is slow.

Treatment.—The quantity of meat scrap or other proteins in the ration should be reduced, and the allowance of green feed increased. Some authorities advocate the administration of saline purgatives, such as Karlsbad salt or Epsom salt, which may be followed by the daily administration of tincture of colchicum, two to five drops, to each affected fowl. In the articular form of the disease, the enlarged joints may be opened and the contents washed out. The joint should then be dressed with a protective bandage.

RICKETS, OR RACHITIS (VITAMIN D DEFICIENCY)

Rickets (rachitis) is a disease of the bones of growing chickens that is most commonly caused by a dietary deficiency of vitamin D. It may be caused also by a marked deficiency of either calcium or phosphorus. The symptoms are poor growth, lameness accompanied by a stiff-legged gait, thickened leg bones and hock joints, and beading at the ends of the ribs. Spinal curvature and crooked breast bones also may be observed.

Treatment.—Permit the chicks to have access to sunlight, or include some cod-liver oil in their diet, or do both. Usually one-half percent of cod-liver oil in an all-mash diet, or 1 percent in a growing mash with which grain is fed, will supply enough vitamin D to prevent rickets. Direct sunlight, not through window glass, is also highly efficacious in preventing rickets. Glass substitutes that permit the passage of ultraviolet rays, may be used. Glass substitutes, however, can be depended on only when they are kept clean. A thin film of dust on either side of the glass substitute prevents the passage of the effective rays just as completely as does ordinary window glass.

PEROSIS, OR DEFORMING LEG WEAKNESS (MANGANESE DEFICIENCY)

Perosis, also known as deforming leg weakness, slipped tendon, and hock disease is a condition that occurs among growing chicks as a result of a diet that is deficient in manganese. This condition should not be confused with rickets, as it appears in spite of an adequate supply of calcium and phosphorus and an abundance of vitamin D.

Symptoms.—The first symptoms noticed are a slight puffiness of the tissues about the tibiotarsal (hock) joint and discoloration due to subcutaneous hemorrhage. This stage is known as enlarged hocks, and if it does not go beyond this stage the bird may recover without permanent deformity. During this stage bending of the distal end of the tibia or the proximal end of the metatarsal bone may occur, which permits the Achilles tendon to slip from the condyles to either the inside or outside of the joint, causing the chick to lose control of the legs. Contraction of the tendon increases the deformity by further bending of the bones and causes permanent flexion of the leg so that the chick is unable to walk at all, and it sits or hops about on the hocks. This results in the bruising of the joint and frequently in the rupture of the synovial sac and joint infection.

Control.—Control consists in prevention rather than treatment as the disease cannot be cured after the resulting deformity has occurred. It is best controlled by making sure that the diet of the parent stock, as well as the diet of the chicks, contains about 50 parts of manganese per million parts. To insure that the diet contains an adequate quantity of manganese, it is suggested that a mixture of 100 pounds of common salt and 1.7 pounds of anhydrous manganous sulfate (or 2.2 pounds of manganous sulfate—tetrahydrate) be used in place of the salt in the feed. One-half percent of this mixture should be included in all-mash diets and 1 percent in growing and starting mashers, with which grain is to be fed. When used at these levels, this mixture of salt and manganous sulfate will supply about 30 parts of manganese per million parts of total feed. Since the feed itself will, in practically every case, supply at least 20 parts of manganese per million, the use of the salt mixture will insure the presence of at least 50 parts of manganese per million parts of feed.

AVIAN ENCEPHALOMALACIA, "CRAZY CHICK" DISEASE (VITAMIN E DEFICIENCY)

One form of so-called crazy-chick disease is the result of a deficiency of vitamin E (alpha-tocopherol) in the diet. This disease appears suddenly at an age between 2 and 4 weeks but seldom if ever after 8 weeks. Apparently very similar conditions may be caused by other dietary deficiencies, the exact nature of which is not known.

Symptoms.—When the chicks attempt to walk they often fall over and wheel in circles. In advanced cases there is frequently complete prostration with legs extended, the head sometimes retracted, and tremors of both head and legs.

Treatment.—Give daily, for 4 or 5 days, 3 or 4 drops of a vegetable oil, such as corn oil, cottonseed oil, peanut oil, or soybean oil to each chick. If the number of chicks is rather large so that individual treatment would be too laborious, include 2 or 3 percent of one of the above-mentioned oils in the diet until the symptoms disappear.

An infectious disease known as epidemic tremor (infectious avian encephalomyelitis) presents somewhat similar symptoms. This disease is discussed under Diseases Caused by Filtrable Viruses.

CHICK DERMATOSIS (PANTOTHENIC ACID DEFICIENCY)

A dermatosis develops in chicks when their diet does not contain enough pantothenic acid, formerly known as the chick antidermatosis factor. The symptoms of a deficiency of this factor are sores and incrustations at the corners of the eyes and mouth, on the bottoms of the feet, and on the joints of the toes. Also the feathering is rough and there is a failure of growth.

Feeds that are good sources of pantothenic acid are alfalfa, milk products, peanut meal, and wheat bran. Among the richest sources are yeast and liver.

"CURLED TOE" PARALYSIS (VITAMIN G DEFICIENCY)

In growing chicks a deficiency of vitamin G results in a lowered efficiency of feed utilization and in a twisted or flexed condition of the toes that is referred to as "curled toe" paralysis. In laying stock a deficiency of this vitamin causes the eggs to hatch poorly.

Good sources of vitamin G are dried whey, dried skim milk, dried buttermilk, alfalfa leaf meal, and the better grades of fish meal and meat scrap.

CANNIBALISM AND FEATHER PICKING

The term "cannibalism" is used by some poultrymen in referring to the habit sometimes developed by poultry of picking one another's feathers, toes, vents, combs, and other parts of the body. Used in this sense, the term includes feather picking, but it is more common to restrict its use to those cases where blood is drawn.

Cannibalism and feather picking probably originate from several causes, such as close confinement, idleness, dietary deficiencies, or the presence of itch mites at the base of the feathers. (See Depluming Scabies.) Experience has shown that it is good practice to allow as much room as possible for exercise and to provide a well-balanced diet. If mites are present, treat as for depluming scabies.

Treatment.—Feather picking, cannibalism, and related vices often can be stopped very quickly and easily by increasing the salt content of the diet for 2 or 3 days. If an all-mash diet is being fed, 2 percent of salt is added; but if both mash and grain are being fed, 4 percent of salt is added to the mash. In most cases the desired effect is obtained within a few hours after the salt is added to the diet, but it may be necessary to feed the extra salt for 2 or 3 days. This salt treatment is recommended for the cure but not for the prevention of feather picking and cannibalism. Ordinarily, it is not recommended that typical all-mash diets contain more than 0.5 to 0.7 percent of added salt or that mashes with which grain or a grain mixture is to be fed contain more than 1 to 1.2 percent of added salt.

If the salt treatment does not stop the feather picking or cannibalism within 3 days, it may be necessary to trim back to the quick the upper mandible of the beak of each chicken. This may be done with a sharp knife or a hot soldering iron. The trimming of the beak is painless, if it is done properly. Ordinarily, only about three-sixteenth of an inch of the tip of the beak is removed; the proper amount can be judged readily by the appearance of the beak substance.

INFECTIOUS AND CONTAGIOUS DISEASES

DISEASES CAUSED BY SPECIFIC GERMS

Pullorum Disease (Bacillary White Diarrhea)

Pullorum disease (bacillary white diarrhea) is quite widespread existing in every section of the United States where appreciable numbers of poultry are kept. It causes heavy financial losses, resulting from the deaths of baby chicks, diminished egg production in hens and pullets, reduced hatchability of eggs, and occasionally the deaths of hens due to generalized pullorum infection. Pullorum disease at times causes severe losses among turkey poults which were incubated or brooded in contact with pullorum-diseased chicks. This danger is largely overcome by incubating turkey eggs separately and rearing the poults apart from chicks. Fortunately pullorum disease does not attack other species of domestic fowls to any serious extent.

Cause.—The disease is caused by a toxin-forming germ which is

known as *Salmonella pullorum*. Although this germ is quite easily destroyed by direct sunlight, heat, or disinfectants, it has been known to remain alive in soil or manure in sheltered places for many days, or even months. The primary seat of pullorum infection is the ovary of the infected hen.

Mode of dissemination.—The disease is commonly transmitted from the hen to the chick by means of the egg (fig. 1). All eggs laid by an infected or "carrier" hen do not contain the organism *Salmonella pullorum*, but infected eggs, if hatched, produce infected chicks. Such chicks may die of the disease any time during the first 3 weeks of their lives, or they may survive to maturity and repeat the cycle (fig. 2) by themselves producing eggs and chicks infected with the organism. Chicks having the disease are constantly voiding enormous numbers of the germs in their droppings, thereby spreading the infection. The hatching of infected eggs in an incubator or under a hen may result in the transmission of the disease to other chicks hatched from uninfected eggs in the same incubator or brood. Infected chicks placed in a brooder house with healthy chicks will spread the disease. In the case of the hatchery chicks, however, the danger of acquiring the disease is multiplied by the fact that the eggs for hatching are frequently assembled from a number of flocks, and if one or more of these flocks happen to be harboring the infection, the entire output of the incubator is exposed to the menace of the disease. Many progressive hatcherymen have already realized the importance of taking the initiative in protecting their customers from pullorum disease by requiring the flocks which supply them with eggs to be tested for the presence of pullorum-disease carriers and by using proper hygienic measures in their hatcheries.

Symptoms.—In hens and pullets pullorum disease is limited as a rule to the egg-making organs, and consequently produces no outward symptoms. It may, therefore, exist unsuspected in a flock. In chicks the symptoms of the disease and the deaths which it causes are sometimes wrongly attributed to some other cause, such as fungous pneumonia (aspergillosis), chilling, or overheating. The presence of the disease may be recognized by the following principal characteristics, although a definite diagnosis cannot be made from these alone. In order to diagnose definitely the disease in chicks, clinical observations must be confirmed by bacteriological proofs.

Pullorum disease is observed in chicks from the time of hatching until they are about 2 weeks old. The chicks may die suddenly after having shown but slight symptoms for a short time. Generally, however, they will first seem disposed to huddle together, or remain too much of the time under the hen or the hover. They soon appear drowsy and indifferent to their surroundings. They stand about with closed eyes and ruffled plumage, listlessly picking at their feed from time to time, but apparently not eating it. Their droppings may be whitish, foamy, and sticky, or sometimes brownish in color. Hence the name "bacillary diarrhea" is in some cases an inaccurate description of the disease. Sometimes the excrement sticks to the down in the region about the vent and accumulates until it completely covers and plugs the opening. This condition, known as "pasting up behind," unless soon relieved, will quickly cause the death of the chick. When attempting to void the excrement sick

chicks utter shrill cries of pain. Labored breathing signals the approach of death, which may then come quickly, or after a period of extreme prostration. The death rate in infected broods may range from 50 to 80 percent.

Post mortem appearance.—In hens and pullets the outstanding change brought about by the disease is that seen in the ovary. In making an autopsy of fowls that have died, or when preparing fowls for the table, the ovaries should be examined for lesions of pullorum disease. In an infected ovary the partially or wholly developed yolks are angular in outline, shrunken, hard, and of an abnormal brownish or greenish color (fig. 1, b). At times yolks containing dark fluid are observed. The presence of *Salmonella pul-lorum* in the diseased ova can usually be determined by laboratory methods.



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FIGURE 1.—a, Normal ovary of fowl; b, ovary affected with *Salmonella pul-lorum*. (After Rettger.)

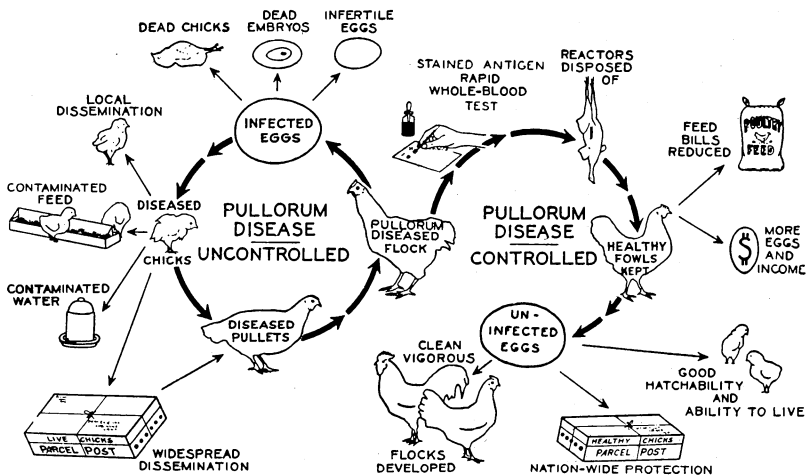
In chicks dead from pullorum disease the presence of noticeable changes depends somewhat upon the age of the chick at death. Those from 1 to 5 days of age often fail to show visible internal evidences of the disease. Chicks dying at 6 days of age and upward very often show small necrotic spots, like whitish deposits, in the lungs, in the muscles of the heart, and possibly on the outer surface of the intestines. The absence of any pathological changes on autopsy does not, however, mean that the disease is not present. The germs sometimes inhabit practically every organ in the chick's body, but they are most frequently recovered from the heart, liver, lungs, the un-absorbed portions of yolk, and from the blood. Determining the presence of this infection in fowls of any age requires special training as well as the use of equipment and materials not generally available outside the laboratory. It is usually possible to have an expert examination made of suspected cases of pullorum disease at any of the State agricultural experiment stations.

Control.⁵—There is no medicinal treatment, or method of vaccination which is of known value in the prevention or cure of pullorum disease in chicks or hens. The very nature of the disease renders

⁵ The control of pullorum disease in connection with the National Poultry Improvement Plan is discussed in Miscellaneous Publication No. 300, which may be obtained gratis from the U. S. Department of Agriculture, Washington, D. C.

treatment both futile and undesirable. Flocks which harbor the infection should not be used for breeding purposes. The cycle of infection established by the hen, the egg, the recovered baby chick, and the pullet (fig. 2) indicates that it is not advisable to save for breeders any chicks which have been exposed to an outbreak of pullorum disease. Hens which harbor the infection in their ovaries are likely to lay infected eggs from which diseased chicks will be hatched. The only practicable means of controlling pullorum disease, therefore, is to detect the carriers and eliminate them from the flock. The premises should be thoroughly cleansed and disinfected.

Methods of diagnosis of pullorum disease.—Various methods have been developed for the detection of carriers of pullorum disease in flocks. The decision as to which method shall be adopted in a given case will depend largely upon the kind of service available.



71056-B

FIGURE 2.—Graphic comparison of serious effects of uncontrolled pullorum disease with the benefits resulting from the use of the agglutination test and the disposal of reactors.

The agglutination test.—Three different forms of the agglutination test are in use at the present time: (1) The long method, or tube test, (2) the rapid serum method, and (3) the rapid whole-blood method.⁶ For practical purposes these three methods may be considered equally reliable for the detection of pullorum-disease carriers.

The long method, or tube test.—This method of testing is strictly a laboratory procedure and is not adaptable to field use. A small sample of blood is collected from each fowl to be tested, and the clear serum is allowed to separate from the clot. A proportionate amount of the serum is mixed with an antigen consisting of a standardized suspension of *Salmonella pullorum* organisms. After thorough agitation the mixture is incubated for 1 to 2 days, and finally examined for the presence of an agglutination reaction, which is manifested by the clearing of the fluid and clumping of the bacteria in the bottom of the test tube, indicating that the hen is infected with the germ of pullorum disease. In negative cases there is no clearing of the mixture, and no clumping of the bacteria.

⁶ The rapid whole-blood test is more fully discussed in Miscellaneous Publication 349, Use of the Rapid Whole-Blood Test for Pullorum Disease, issued by the U. S. Department of Agriculture.

The rapid serum test.—Although this method is essentially a laboratory procedure, it may, with certain preparations, be made adaptable to field use. With this method the undiluted clear serum of the fowl to be tested is mixed with a highly concentrated antigen on a glass plate or slide, over an illuminated dark background. The antigen employed is a standardized suspension of *Salmonella pullorum* in a concentrated solution of sodium chloride preserved with phenol. For the test, a pane of glass forms the top of a black-lined box illuminated by a frosted incandescent bulb within. The two substances are mixed by the aid of a toothpick. The reaction may occur immediately or may require several minutes. A positive reaction consists in the formation of visible clumps of the bacteria and a clearing of the intervening fluid. A negative test remains uniformly cloudy, without any clumps forming.

The rapid, whole-blood test.—This test is somewhat similar in its mechanism to the rapid serum test previously described, but owing to its simplicity and facility of operation, it is well adapted to field use. Outstanding advantages of the rapid, whole-blood test are as follows: (1) The use of a single drop of fresh, whole blood immediately after it is obtained from the fowl; (2) the stained antigen, which makes it easy to detect reacting cases over a white background without artificial illumination; and (3) the fact that the presence or absence of pullorum infection is immediately diagnosed with one handling of the fowl and reactors are disposed of at the time of the test, eliminating the necessity of banding the fowls.

The antigen for the rapid, whole-blood test is composed of a heavy suspension of *Salmonella pullorum* in physiological saline solution preserved with formalin and stained with crystal violet.

In the application of this test a drop of blood is obtained by pricking the wing vein with a sharp-pointed instrument. The drop of blood is picked up with a wire loop and immediately mixed with one drop of stained antigen on the test glass or plate. The antigen is usually placed on the glass first, and the drop of blood is added to it. With the same wire loop, the antigen-blood mixture is stirred for a moment and then spread out on the glass to a diameter of about 1 inch. When the glass is rocked from side to side a few times, over a sheet of plain paper or other white background, the agglutination usually becomes visible in from 5 seconds to 2 minutes in reacting cases. In negative cases it remains uniformly turbid (fig. 3). Following each test, the loop is rinsed in clean water and dried on a clean towel in preparation for the next test.

The intradermic test.—This method consists in injecting into the wattle a small amount of a diagnostic agent prepared from a broth culture of *Salmonella pullorum*. In applying the test, the fluid is injected between the layers of the skin, slightly above the lower border of the wattle. In reacting cases an edematous swelling of the injected wattle similar to that produced by the intradermic tuberculin test (fig. 5) appears in approximately 24 hours. This test is generally regarded as less accurate than the agglutination test.

Hatchery sanitation in the control of pullorum disease.—Incubators may be disinfected, when not in use, by the following method:

Egg trays, nursery trays, and other readily removable parts should be taken out and scrubbed with a 2-percent commercial-lye solution.

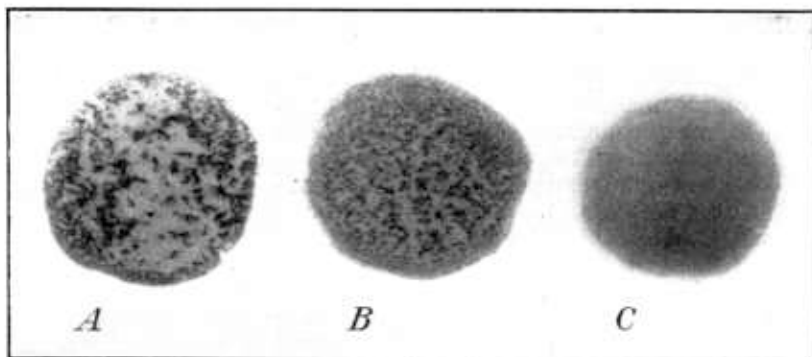
Chick down, droppings, and shell fragments should be removed from the incubator with a brush or vacuum cleaner, and the interior of the machine should be sprayed with a 5-percent formalin solution. The incubator should then be left closed for at least 2 hours to permit the formaldehyde gas to penetrate to all parts of the apparatus.

Fumigation of the incubator room may be accomplished by wetting thoroughly the exposed surfaces with a 5-percent solution of formalin and then leaving the room closed for 12 hours at a temperature not below 60° F.⁷

Chick brooders and brooder rooms, when not in use, may be disinfected in a similar manner.

Fowl Cholera

Fowl cholera is a highly infectious, rapidly fatal disease of all domesticated birds. Birds of any age are susceptible.



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FIGURE 3.—Reactions to the stained-antigen rapid, whole-blood agglutination test for pullorum disease: A, A positive reaction; B, a questionable or suspicious reaction; C, a negative reaction.

Cause.—It is caused by *Pasteurella avicida*, a germ which multiplies to enormous numbers in the blood and various organs of the body, producing a septicemia or blood poisoning. The disease is carried by sick or recently recovered birds which have been placed in a healthy flock, by wild birds, or by persons, animals, or poultry utensils which have been on infected premises. It spreads rapidly throughout the flock, owing to the fact that the first birds to become infected give off great numbers of the germs in their droppings and these are picked up by the other birds in feeding and drinking.

Symptoms.—The first symptom is a yellowish coloration of the droppings. This is followed by yellowish, brownish, or greenish diarrhea. The bird becomes droopy, feverish, and sleepy and sits with the head drawn down to the body or turned backward and resting in the feathers about the wing. Appetite diminishes, and thirst increases. Breathing becomes difficult and may be heard at some distance. Finally the weakness is such that the bird cannot stand but lies with the beak resting on the ground. It sleeps so

⁷ A more detailed discussion of incubator fumigation is given in Miscellaneous Publication 349, Use of the Rapid Whole Blood Test for Pullorum Disease, issued by the U. S. Department of Agriculture.

soundly for some time before death that it can hardly be aroused. The comb and wattles may be a dark-bluish red, and the skin of the breast and abdomen is frequently reddened.

In very acute cases no symptoms are seen; the birds may be found dead under the roosts, or they may fall while feeding or moving about and die in a short time. During an acute outbreak sickness is seldom noticed more than 24 hours before death, which usually occurs within 3 days of the time of infection.

Cholera may destroy the greater part of a flock in a week and then disappear, or it may linger in a chronic form for months, only occasionally killing a bird. The chronic form is characterized by a continually increasing weakness, loss of weight, paleness of head, and finally an exhausting diarrhea. Sometimes one or more joints of the wings or legs swell, the bird becomes lame, and later the swellings break and discharge a creamy or cheesy mass. Swollen wattles are more or less prevalent in some outbreaks. These are characterized by the formation of accumulations of cheesy pus in the wattles caused by localized infection with the fowl cholera germ.

Post mortem appearance.—The heart has red spots or hemorrhages on its surface. The first portion of the intestines is congested and hemorrhagic, and the contents consist of a pasty mass, which may be bloodstained. The vessels of the visceral organs are congested. The liver may be enlarged and darker in color and the spleen may be swollen. A sticky fluid is frequently present in the mouth and nostrils.

Control measures.—Since medicinal treatment of affected birds is futile, the aim should be to prevent, so far as possible, the spread of infection. The first fowls showing acute feverish symptoms should be destroyed by a method which will guard against the contamination of the premises by infected blood. The carcasses should be burned or buried deeply. The healthy fowls should be moved to new quarters, if possible, and carefully watched for signs of the disease. Swollen or edematous wattle cases may be isolated and treated by the surgical removal of the pus content and the irrigation of the abscess cavity with tincture of iodine or 5-percent phenol solution. Houses and runs should be thoroughly cleaned at frequent intervals and disinfected with a reliable disinfectant in proper dilution. The drinking water may be made antiseptic by adding one-third teaspoon of permanganate of potash to each gallon, a procedure which tends to check the spread of disease by means of the water.

Too much dependence, however, should not be placed on the permanent effectiveness of antiseptics in drinking water. If the feed or water supply of the fowls becomes contaminated, it should be removed and a fresh clean supply substituted.

Fowl Typhoid

Fowl typhoid is an infectious disease of chickens and turkeys which has also been observed in other domestic birds. It attacks the blood and internal organs.

Cause.—The disease is caused by *Salmonella gallinarum*, a micro-organism which is introduced on the premises by carriers such as infected fowls, material from infected poultry yards, or free-flying birds, or on the feet of persons or animals which have been on infected premises. Fowl typhoid spreads through a flock in a manner

similar to fowl cholera and most of the other infectious diseases but is not so destructive as the acute form of cholera.

Symptoms.—These are drowsiness, fever, loss of appetite, and general weakness. The droppings are soft and yellowish or greenish. The membranes of the head, comb, and wattles are usually paler than normal, but in acute cases may be darkened with venous congestion. Complete prostration may develop in from several hours to 1 or 2 days before death. Symptoms become noticeable in from 4 to 6 days after infection takes place and last, in fatal cases, from 4 to 12 days.

Post mortem appearance.—The internal parts of the body other than the liver and the spleen have a pale appearance. The mucous membrane or interior lining of the intestine is usually pale. The blood is thin, pale red in color, and does not clot readily. The liver is greatly enlarged and generally dotted with grayish spots. It has a tendency to break easily. The spleen is often swollen, pulpy, and filled with grayish spots. The kidneys are somewhat enlarged and lighter in color or slightly congested. The heart appears normal or pale, with grayish spots on its surface.

Control measures.—The measures advised for cholera apply also to typhoid since medicinal treatment is of no value.

Paratyphoid Infection

Paratyphoid infection of fowls is caused by some organism of the *Salmonella* group, such as *Salmonella typhimurium* (aertrycke) or related types of organisms. *Salmonella pullorum* is in a strict sense a paratyphoid organism but is given special consideration elsewhere in this bulletin owing to its importance as a poultry disease germ. Paratyphoid infection is of widespread occurrence in turkeys, pigeons, ducks, chickens, and other species.

Young turkeys that are affected frequently huddle close to the brooder stove. They manifest weakness, droopiness, stunted growth, inappetence, and in some cases bowel disturbance. Grown birds may show emaciation, inappetence, and a general unthrifty appearance. Death may occur without preliminary symptoms in the young, but older birds may succumb after being affected several days. At autopsy, fluid may be found in the heart sac, and a hard plug or cast may be present in the blind gut.

In grown pigeons the infection may be manifested by the formation of abscesses, particularly affecting the wings and rendering flying difficult if not impossible. Recovery may occur without treatment, and flying may be resumed. Affected squabs may show nervous symptoms, such as shaking of the head, staggering, and leg weakness. Carrier birds may harbor the infection in their lungs.

In chicks and ducklings the symptoms are somewhat similar to those of pullorum disease, the affected birds being weak, listless, and inclined to stay near the hover. Chronic cases become weak, droopy, and unthrifty.

The germs of the disease are frequently recovered from the ovaries or testicles of breeder birds, a fact which suggests the probability that paratyphoid infection may be transmitted through the egg. This is true not only of pullorum disease but of other types of *Salmonella* infection. The disease is spread, also, by the droppings.

Paratyphoid infection may be prevented by selecting young stock of known disease-free origin. The agglutination test is of only limited value in eliminating carriers from the breeding flock, since there are numerous types of infective agents involved and no single antigen could be depended on to detect the carriers. Sanitation, as discussed for the general prevention and control of diseases and, also, under pullorum disease, is recommended for the control of this infection.

Transmission.—The disease is apparently transmitted through the infected ovary to the egg. In pigeons the disease is believed to be transmitted also by the infected secretions of the mouth during bill feeding of the young. If the wing abscesses of affected adult pigeons are not lanced they sometimes recover and eventually the birds are again able to fly. Improper lancing of the wing abscesses may permanently disable the bird.

Prevention.—The disease must be prevented largely by obtaining stock from uninfected sources. It is also important to observe sanitary precautions similar to those customarily used in the prevention of pullorum disease. (See discussion of pullorum disease.)

Fowl Tuberculosis

Fowl tuberculosis is a chronic, infectious disease of domestic and wild birds. It is most common, however, in the chicken and pigeon. It is readily contracted by pigs, rats, and mice, but man is rarely affected by fowl tuberculosis. Parrots and canaries are quite susceptible to human tuberculosis, but fowls are practically insusceptible.

Cause.—The disease is caused by *Mycobacterium tuberculosis avium*. Tuberculosis is generally brought into the poultry yard with fowls that are purchased from infected flocks. If the disease exists in neighboring flocks the contagion may be carried by small birds, animals, or persons passing from one yard to another. A peculiarity of tuberculosis of birds is that the liver and intestines are nearly always very severely affected, and that as a consequence the organisms are very numerous in the intestinal contents and are scattered with the droppings. The introduction of a single diseased bird, therefore, may cause the infection of the greater part of the flock in a few weeks. In the same way, when wild birds contract the disease, the germs are carried and deposited in yards which they visit.

Pigs, rats, and mice are especially liable to be infected with fowl tuberculosis by eating the carcasses of birds which have died of it, and these animals serve to keep up the contagion and may communicate it to other fowls, especially if the latter eat the carcasses of rats or mice that have died of the disease.

Symptoms.—Although birds may become infected at any age, the disease usually progresses slowly, and symptoms are generally not observed until the affection has reached an advanced stage. Hence it is the older fowls, those more than 1 year of age, which display the most pronounced symptoms and show a high death rate.

Signs of disease begin with gradual loss of weight, wasting of the muscles, especially noticeable in the breast, paleness of the comb,

and toward the end, dullness, sleepiness, and diarrhea with yellowish or greenish droppings. Very often there is at the same time a tuberculous inflammation of the joints and of the sheaths of tendons, which is revealed by lameness and swelling of the joints and legs. Occasionally the skin over the swollen joint breaks, the interior of the joint is ulcerated, and a small quantity of cheesy material is discharged. Deaths in the flock occur at intervals. Affected birds may live only a short time after symptoms are noticed, or they may live for weeks.

Post mortem appearance.—On post mortem examination grayish-white or yellowish tumors of varying sizes are observed in the internal organs, but especially in the liver (fig. 4), spleen, and intestines. These tubercles when cut open present a solid, grayish, glistening interior which in the larger ones, exhibits yellowish centers or a number of yellowish points. Those of more advanced growth show extensive yellowish, cheesy or crumbly masses in their interior.

• **Distinguishing tuberculosis from other diseases.**—

The diseases which may be confused with tuberculosis of birds by similarity of lesions are: Tumors or cancers of the abdominal organs, tapeworm nodules in the intestine, fungous condition of the lungs, blackhead of turkeys, blood poisoning which produces an enlarged, spotted liver, leukemia (big-liver disease), or gouty swelling of the joints. These diseases are described elsewhere in this bulletin. The prominent lesions of the conditions mentioned are usually limited, however, to certain specific organs instead of being spread to the variety of organs attacked in tuberculosis. A definite diagnosis may be had in all cases by microscopic examination of the disease processes. Avian tubercles contain extremely numerous tubercle organisms which are readily seen in laboratory examination.

Testing fowls for tuberculosis.—Diagnosing tuberculosis in living fowls is possible by means of the intradermic tuberculin test. The



444-D

FIGURE 4.—Tuberculous organs of fowls. Note spots on liver and its greatly enlarged condition.

test fluid used is prepared from bouillon in which avian tubercle bacilli have grown for several weeks. The fluid must be injected, by means of a small-caliber syringe with a 26- or 27-gage needle, into the deeper layer of the skin of the wattle. Slightly less than 1 drop, about one-twentieth of a cubic centimeter, is forced into the skin just beneath the surface, and not deep enough to penetrate the skin or enter the underlying connective tissue of the wattle. Only one wattle is injected, the other being left for comparison. Forty-eight hours after the injection, a swelling in the wattle indicates a positive reaction and the presence of tuberculosis in the fowl (fig. 5). The presence of



22304-C

FIGURE 5.—Fowl showing swollen wattle, following tuberculin test, indicating the presence of tuberculosis.

tuberculous fowls in a flock may be detected by this test, which should be applied by a veterinarian.

Prevention and eradication.—No treatment will cure tuberculous birds. The most thorough method of eradication is to slaughter the entire flock when indications point to an extensive outbreak. Fowls in good flesh, showing no lesions or slight ones, may be used for food, provided all affected organs and parts are removed and the meat is thoroughly cooked. Those badly

diseased and all visceral organs of the others should be destroyed.

The chicken houses, enclosed runs, and all eating, drinking, and other utensils should be thoroughly cleaned and disinfected as previously specified. After disinfection the premises should be kept free of fowls for a year. New stock should be placed on ground which has not been occupied by poultry for a year or more. Obtain birds or eggs for hatching from flocks which are free from infectious diseases. When the breeding value of the fowls makes it undesirable to dispose of the entire flock by slaughter, tuberculosis may be controlled and even totally eradicated by supplementing the customary culling measures with the tuberculin test and sanitation. As has been stated, the disease develops very slowly, and for that reason it is advisable to dispose of birds when they reach the age of 18 months, or at the end of the first laying period. From an economic standpoint also, except possibly in the case of breeding stock, this is sound policy, as the egg yield decreases after the first year of laying. Younger birds should be disposed of whenever they appear to be abnormal. This procedure alone will greatly assist in holding tuberculosis in check.

Apoplectiform Septicemia

Apoplectiform septicemia is a rapidly fatal disease of chickens, turkeys, pigeons, and other fowl which is caused by the germ *Streptococcus capsulatus gallinarum*.

Symptoms.—Symptoms may consist of depression, inappetence, listlessness, staggering gait, and finally prostration and death. However, the progress of the disease is so rapid that death may occur without noticeable symptoms.

Post mortem appearance.—There is usually a discoloration of the skin of the breast and neck caused by subcutaneous hemorrhages. Serous or bloody exudates may be seen in the heart sac and body cavity. The liver, spleen, and kidneys, may be greatly swollen, and in addition a false membrane may be spread over the surface of the liver. The intestines are thickened and congested, with bloody contents. The lungs may be congested or pneumonic.

Control.—Observe the sanitary precautions outlined early in this bulletin. Healthy fowls may be successfully vaccinated against apoplectiform septicemia by the intravenous injection of a killed culture of the causative organism.

Infectious Coryza (Coryza, Rhinitis, Roup, Cold)

Infectious coryza is an infectious and contagious disease of chickens and other species of fowl which spreads rapidly through poultry flocks, attended by variable mortality.

Cause.—The disease, as recognized in chickens, is caused primarily by the germ *Hemophilus gallinarum*. There is no doubt, however, that the condition is aggravated and prolonged in some cases due to secondary invasion by certain pus-producing organisms. Exposure to unfavorable living conditions also tends to lower the fowl's resistance to respiratory infection.

The cause of related diseases in other species of birds has not been definitely determined.

Symptoms.—The principal symptoms of infectious coryza are a bloody or mucous exudate in the nasal passages and sinuses usually accompanied by mouth-breathing. An offensive odor is frequently present. The inflammation soon extends to the eyes, causing swelling and redness of the membranes, and a foamy lachrymation. This tends to dry and stick the eyelids together. Some cases develop more or less swelling of the sinuses below the eye, due to impaction with cheesy pus, the pressure of which may eventually destroy the eye or cause loss of vision (fig. 6). Others manifest a generalized edema of the region of the head and neck. There is initial fever, loss of appetite, weakness, and sometimes coma and death. During the progress of these symptoms the obstruction of the air passages with exudates causes difficult respiration, accompanied by loud breathing.

In severe and advanced cases the birds sit in a drowsy or semi-conscious condition, unable to see or eat; their strength is rapidly exhausted, and many of them die within a week or 10 days. Some of the affected birds recover, but others remain weak and have a chronic form of the disease for months.

This disease is distinguished from diphtheria (fowl pox) by the absence of the thick, tough, and very adherent cheesy exudates in the mouth and throat which are characteristic of diphtheria. Some-

times there may be a deposit of yellowish material on the walls of the mouth and throat, but it is easily broken up and removed. There are no warts on the comb, face, or wattles.

If mouth breathing is long-continued, it eventually brings about a horny, dried condition of the tip of the tongue, commonly called "pip." This may be prevented by applying petrolatum to the tongue.

Treatment.—The sick birds should be removed from the flock and put in a warm, dry, well-ventilated room free from drafts. The affected mucous membranes of the nostrils and mouth may then be treated with antiseptic solutions. A special nasal irrigator for poultry is on the market, consisting of a rubber bulb to which is attached a metallic nozzle for forcing the solution through the cleft palate and out through the nostrils.



14050-B

FIGURE 6.—Head of fowl affected with coryza, showing swelling of the eye.

The antiseptics most suitable for such treatment are: Boric acid 1 ounce, water 1 quart; or permanganate of potash 2 drams, water 1 pint; or peroxide of hydrogen 1 ounce, water 3 ounces. When the inflammation has reached the eye, placing one or two drops of a 15-percent argyrol solution or a 4-percent solution of silver nitrate between the eyelids twice daily for several days may give relief.

Before applying any of these substances wash the eyes and mouth with warm water containing one teaspoonful of common salt to a quart. Use a pledget of absorbent cotton and rub gently, at the same time press and massage about the nostrils and under the eyes to loosen the accumulated secretion. If there is a swelling under the eye, it should be opened carefully with a sharp, clean knife, all the excretion removed, and the cavity washed with one of the above-mentioned solutions. A pledget of cotton moistened with the argyrol or silver nitrate solution may be left in the opening for an hour or two. Various types of germs have been observed as secondary invaders in the cheesy eye exudates of so-called "roupy" fowls. Bacterins prepared from strains of *Staphylococcus aureus* recovered from affected birds have given encouraging results as an aid in checking the spread of the condition.

The houses should be kept clean and dry and occasionally should be disinfected. If the disease is of a severe type, it is often better to kill the affected birds.

"SWELL HEAD," OR SINUSITIS, OF TURKEYS

This is a condition manifested by the filling of the sinuses of the head of turkeys with exudates of a more or less fluid consistency. It may run a chronic course in a flock, persisting at times for a number of weeks.

Cause.—This condition is believed to be of infectious origin, although the cause is not definitely known. In some respects it is considered somewhat similar to infectious coryza. Similar manifestations may also follow a deficiency of vitamin A (see Nutritional Roup).

Symptoms.—At first the birds shake their heads to dislodge the nasal exudates. Later foamy lachrymation appears in the eyes, after which the eyes partly or completely close, and the sinuses swell. Loss of vision and inability to eat cause the birds to lose weight rapidly. Difficult breathing may be observed also. Some deaths in the flock may occur from emaciation or pneumonia.

Treatment.—The Utah Experiment Station has reported the following treatment for the early stages of swell head of turkeys to be effective: First withdraw the fluid from the sinus by means of a glass syringe and an 18-gage needle, after which the syringe may be detached and the needle left in position. The exudate is emptied into a receptacle of disinfectant. A second syringe is then filled with a 4-percent solution of silver nitrate, of which 1 cc. is injected into the sinus and worked through the tissues by gentle massage. In severe cases the treatment may be repeated.

DISEASES CAUSED BY FILTRABLE VIRUSES

Fowl Pox (Diphtheria)

Fowl pox and diphtheria are but external and internal manifestations, respectively, of the same disease. The virus which causes the formation of warts or pox nodules on the head, typical of fowl pox, also causes the cheesy patches in the mouth and eyes which are characteristic of diphtheria. Chickens and pigeons are most frequently affected, but turkeys and birds generally are susceptible.

Cause.—Fowl pox is caused by a virus which is capable of passing through laboratory filters and cannot be seen even with a powerful microscope. The disease is strictly infectious and never develops as a result of exposure to dampness and drafts alone, although these conditions favor its spread and tend to increase its malignancy.

Transmission.—The contagion is introduced and disseminated in a flock by contact with infected (carrier) birds. Its spread depends upon the presence of abrasions of the skin or mucosa of the mouth parts. Pox virus may be disseminated also by mosquitoes.

Canker of pigeons may be disseminated from infested parents to their offspring during the act of bill feeding. The eggs or squabs of such breeders should be given to healthy foster parents.

Symptoms.—The disease has the general symptoms of roup but is distinguished from it by an eruption of pox nodules on the head and by the presence, in the mouth, throat, and eyes, of tough, cheesy patches which are firmly attached to the tissues beneath them (fig. 7).

The eruption appears as round, oblong, or irregular shaped nodules from the size of a pinhead to that of a pea or a hazelnut. It is seen especially about the beak and nostrils and on the comb, the eyelids, the wattles, and the ear lobes. In some birds, particularly in pigeons, the eruption is more generalized and is found on the skin of other parts of the body, as the neck, under the wings, on the rump, and about the vent. Here the nodules may become larger than on the head. The nodules begin as small, red, or reddish-gray growths with

a shiny surface and gradually enlarge, while the color changes to a yellowish, brownish, or dark brown, and the surface dries and becomes shriveled, uneven, and warty in appearance. Owing to the number of nodules and the extension of the inflammation, large patches of skin become thickened and covered with hard, dry crusts, closing the nasal openings or the eyelids, and making it difficult to open even the beak.

The severity of the disease depends much on the extent of the internal diphtheritic deposits (fig. 8). These are at first thin and yellowish or whitish in color, and gradually become thicker, firmer, and more adherent, so that considerable force is required to remove them. The mucous membrane beneath the deposit, when the latter



26319-B

FIGURE 7.—Fowl-pox nodules on comb, on wattles, and near corner of mouth. (After Hutýra and Marek.)



26320-B

FIGURE 8.—Diphtheria. Neck slit open to show diphtheritic patches in mouth and esophagus. (After Rátz.)

is removed, is found to be inflamed, ulcerated, and bleeding, but it is soon covered by a new deposit. This exudate is called a false membrane, and when it is situated where the breathed air passes over it, it dries and becomes uneven and fissured, and its color changes to a dark brown. In pigeons the exudate is more friable and easily removed, and the mucous membrane beneath it is reddened but not ulcerated.

While the false membranes over the parts first affected are becoming thicker, the inflammation extends to the adjoining surfaces, and new diphtheritic centers develop, uniting with one another until the cheeks, tongue, palate, throat, and inside of the nostrils are covered. Very often the inflammation extends from the nostrils to the eyes, and sometimes it penetrates the air tubes to the lungs, or the gullet to the crop. When false membranes form in the gullet, crop, and intestines there is a rapid aggravation of the symptoms,

such as intense diarrhea, and the escape of blood with the droppings. This type of the disease is more frequent in waterfowl than in other birds. Some fowls in a flock are resistant, and after a few days of illness rapidly recover. Others remain dull, weak, and thin in flesh, and may have more or less catarrh and difficulty of breathing for a long time.

The period between exposure to the contagion and the appearance of the first symptoms varies from 3 to 15 days. The duration of the disease varies from 2 or 3 days to as many weeks in the acute cases, while the chronic form may continue for several months.

Treatment.—The treatment of fowls severely affected with diphtheria requires much time and patience, and as a rule does not pay. It is often better to kill the birds, bury or burn their carcasses, and disinfect the poultry houses, and in that way eradicate the contagion as soon as possible.

If it is decided to treat the sick birds they should be removed from the flock and put into a comfortable, well-ventilated room that may be easily disinfected. Remove from the mouth or larynx the false membranes which interfere with eating or breathing, and apply tincture of iodine or argyrol. If the eyesight is threatened by large swellings under the eyes, open the swellings, remove the cheesy pus, and apply either of the disinfectants mentioned.

As this disease is contagious, the houses, drinking vessels, and feed troughs should be kept disinfected during the outbreak and for several days after all the birds have apparently recovered. The drinking water is made antiseptic by dissolving one-third of a teaspoon of permanganate of potash in each gallon.

Prevention.—In order to diminish the possible interference with the productivity of the flock, the birds should be vaccinated at 3 to 5 months of age. Vaccination of a flock of poultry is not recommended, however, under any circumstances, unless the disease has been known to exist on the premises, or the owner considers that his flock is in danger from infection in neighboring flocks. Neither should chickens be subjected to the ordeal of vaccination when in a debilitated, sickly condition, or when heavily infested with parasites. Show birds or those in egg-laying contests should be immunized against pox at least 6 weeks before being sent to exhibitions or contests.

There are two methods of vaccination, the stab, or stick, method and the follicle method. The stab method is a more recent development and seems to have several advantages over the older follicle method; vaccination can be accomplished much more easily and quickly, much less vaccine is required, and it is more sanitary.

In the stab method a narrow, sharp-pointed knife or lancet with adhesive tape wrapped around the blade about one-eighth inch from the point is used. Vaccination is accomplished by dipping this instrument into a bottle of vaccine and making a quick stab sufficient to penetrate the skin. The most convenient site to vaccinate by this method is on the outside of the leg near the "knee" (patellar) joint where the rows of feathers are far apart and the stab can easily be made between the rows.

A variation of the stab method recently reported is the use of two sewing-machine needles pushed through a cork with the points about one-fourth inch apart. When this instrument is used the wing is

stretched out and the web is pierced from the under side, thus making four vaccination points through the double layer of skin simultaneously. The eyes of the needles take up sufficient vaccine to make it effective.

When vaccinating is done by the follicle method the procedure is as follows: Pluck out several feathers from the front part of one leg, and with a cropped, bristle brush, or other suitable applicator, rub the vaccine into the empty feather follicles.

The reaction denoting a so-called vaccination take may be noticed in 5 to 7 days. The site of vaccination will show inflammation and later the formation of a scab, which will drop off in about 30 days.

Some investigators in Europe and the United States have advocated the use of the virus of pigeon pox for the vaccination of chickens against fowl pox, claiming for this method the establishment of a satisfactory immunity with no appreciable disturbance of health or egg production. Pigeon virus vaccine is always administered by the follicle method. Pluck from 12 to 15 feathers and brush the vaccine vigorously into the follicles. This virus and technique must be used in immunizing pigeons also.

Infectious Laryngotracheitis (Influenza, "Flu")

Infectious laryngotracheitis is observed among chickens during the fall and winter months, especially in the large, central, poultry-feeding establishments of the Middle West, and during the shipment of the fowls by rail to the principal poultry markets.

Cause.—The disease is caused by a filtrable virus.

Symptoms.—Difficulty in breathing causes the bird to extend the head and open the beak for each respiration (fig. 9), and there is usually a rattling noise caused by obstruction of the windpipe. The bird becomes ruffled and unkempt. The facial expression is distressed. Appetite rapidly diminishes. Sticky exudates in many cases are present in the mouth and nasal cavity.

Affected birds may recover, although many die within 3 or 4 days after exposure, or may succumb after a week or 10 days. Death is usually caused by asphyxiation from the mechanical obstruction of the windpipe with dry, cheesy exudates. These are, as a rule, more darkened and fibrinous than those of diphtheria, and are found only in the air passages.

Post mortem appearance.—Autopsy reveals no significant lesions except an inflammation of the nasal tract and windpipe, which are obstructed with a mucopurulent or fibrinous exudate, frequently tinged with blood.

Treatment.—No satisfactory flock treatment is known. Individual cases have been benefited by the repeated removal of the dried exudative plug from the windpipe, and placing the sick birds in small groups in warm but well-ventilated quarters.

Control.—The control of this disease is favored by the application of such measures as cleaning and disinfecting the premises, destroying all sick birds, burying or burning all carcasses, and providing comfortable, spacious, and well-ventilated quarters for the flock.

The eradication of the disease necessitates the rigorous application of sanitary and hygienic precautions. The essential points of a plan of eradication of infectious laryngotracheitis which is in use in Massa-

chusetts are given in the following paragraph. This plan is especially adaptable to isolated outbreaks of the disease, or outbreaks occurring in areas where the poultry population is small or segregated in remote units.

Gather the required number of eggs for hatching and then dispose of the entire breeding flock which has been exposed to or affected with the disease. Cleanse and disinfect incubators and brooders, and remove them to a safe distance from the disease-infected premises. Use every sanitary precaution in hatching the eggs and brooding the chicks. Cleanse and disinfect buildings and equipment used by the diseased flock as soon as possible after their removal. Then open the doors and windows, allowing the air and sunshine to enter and let the houses remain vacant for 2 months or longer. No clothing or footwear worn around the diseased flock or their premises should be worn when working with the chicks for restocking, unless such apparel has been thoroughly cleansed or disinfected. Introduce new stock only from flocks known to be free of the disease, or raise chicks from your own safeguarded hatches. Safeguard the flock from the introduction of the disease by chickens from diseased flocks, visitors from contaminated localities, hucksters, stray dogs, and similar sources.

The New Jersey Agricultural Experiment Station has developed a vaccine for the prevention of infectious laryngotracheitis. This product is prepared by rapidly drying and pulverizing the tracheal exudates of affected fowls. The powder is mixed with a measured proportion of sterile fluid and is applied to the bursa of Fabricius (an invaginated sac adjacent to the cloaca) with a small bristle brush or swab. A temporary local reaction, about the fifth day, consisting of an inflammation of the vaccinated area, shown by redness and swelling, is regarded as an indication that the vaccination was successful.

This vaccine should not be used in flocks except where the disease has already existed or is dangerously prevalent in the vicinity, since the introduction of the living virus in this way may produce the active disease, and necessitate future vaccinations on the premises. Debilitated birds or birds less than 6 weeks of age should not be vaccinated against this disease.

Bronchitis (Chick Bronchitis, Gasping Disease)

Bronchitis is an infectious and contagious respiratory disease affecting, principally, young chicks.

Cause and symptoms.—The disease is caused by a filtrable virus and is manifested by gasping and coughing, throat rattles, and in some cases nasal discharges and swollen eye sinuses. Usually the disease affects birds from 2 to 9 days of age, sometimes older ones.



FIGURE 9.—Hen affected with infectious laryngotracheitis, showing typical appearance due to difficult breathing. (Photo by J. R. Beach.)

The symptoms may continue for several days, after which some deaths may occur, and the survivors will slowly recover. Recovery from this disease is attended with immunity to further attacks. Older birds if affected will recover more rapidly. The principal lesion observed on autopsy is bronchial pneumonia caused by a filling up of the bronchi and bronchioles with a mucous or cheesy exudate.

Control.—The condition may be brought under control by carrying out the following precautions:

Eliminate all affected fowls. If the condition is widespread or continues to increase, dispose of all live chicks on the premises, in order to eliminate the carrier problem. Thoroughly clean up the quarters, flushing down the ceilings, walls, and floors with a hose, and disinfect with a recognized germicidal solution. Where tight construction prevails, as in hatcheries, fumigate with formaldehyde. Introduce new chicks or eggs only from sources known to be free of the disease.

There is no medicinal treatment for bronchitis. Birds that recover are immune to further attack.

Avian Leukosis Complex (Fowl Paralysis, Lymphomatosis, Leukosis)

Fowl paralysis is a complex disease having several manifestations and affecting chickens and, to a limited extent, turkeys and pheasants. The disease may manifest itself by paralysis of the limbs, "gray eye" and blindness, tumor formation, and leukemia.

A great deal of investigational work has been done and is being done on this disease, but as yet complete information on the cause, methods of spread, and control is not available.

Susceptibility.—All breeds are about equally susceptible, but there is a great variation in the susceptibility of different strains and of individuals within the strain. Thus, there are strains of fowls distinctly resistant or susceptible to fowl paralysis, and either of these characteristics may be transmitted to the offspring.

Baby chicks seem to be most susceptible to artificial infection. This susceptibility decreases, however, with age. In natural outbreaks the disease occurs in birds from 6 weeks of age to over a year old, the greatest losses occurring between 4 and 8 months of age.

Although baby chicks are most susceptible to the disease, the greatest losses occur in the older birds because of the incubation period of 2 months or more. Although only one or two birds come down at a time, it is a continuing occurrence, and over a period of a year losses may amount to 50 percent of the flock or more.

Cause.—The disease may be reproduced experimentally in susceptible birds by a filtrable virus. Whether or not other agents or conditions such as diet, management, and parasites play an important role in causing the disease has not been fully investigated.

Symptoms.—There is at present no method of diagnosing the disease in live birds which will eliminate all the birds that may be carrying the agent causing the disease.

Two manifestations of the disease are commonly seen, paralysis of the limbs and gray eye. Perhaps the most common and most striking type is that in which the nerves to the legs or wings are affected, with resulting lameness or drooping of the wings. In acute cases in young birds on the range the onset may be sudden, the first noticeable symp-

tom being a slight limp. The lameness usually becomes progressively worse so that the bird becomes prostrated in a few days. Paralysis of the limbs is usually not complete, and the bird, although unable to stand, may still be able to kick when disturbed. A characteristic posture in the later stages of the disease is one in which the bird lies on the breast with one leg extended forward and the other backward. Either one or both legs or wings may be affected. In cases in which the wing is dropped, enlargement of the wing nerve may sometimes be noted at the point where it crosses the radius bone on the inside of the wing at the elbow joint.

Other less common symptoms of involvement of the nervous system are (1) torticollis, or spasm of the neck muscles causing the head to be drawn to either side, down between the legs, or straight back with the beak pointing up, and (2) incoordination, varying from a slightly weaving gait to falling or turning somersaults.

In gray eye there is a loss of the bay color in the iris ranging from a narrow pale ring around the margin of the pupil to total grayness of the iris, when the eye often presents a glassy appearance. In advanced cases, the pupils frequently become irregular in outline, very small, or eccentric, and there may be bulging of the eyeballs. In advanced gray eye there is generally partial or complete blindness. Some birds with gray eye appear to be otherwise healthy and may lay fairly well. Gray eye is more often seen in mature birds.

Other symptoms of disease sometimes associated with paralysis outbreaks are skin tumors and anemia.

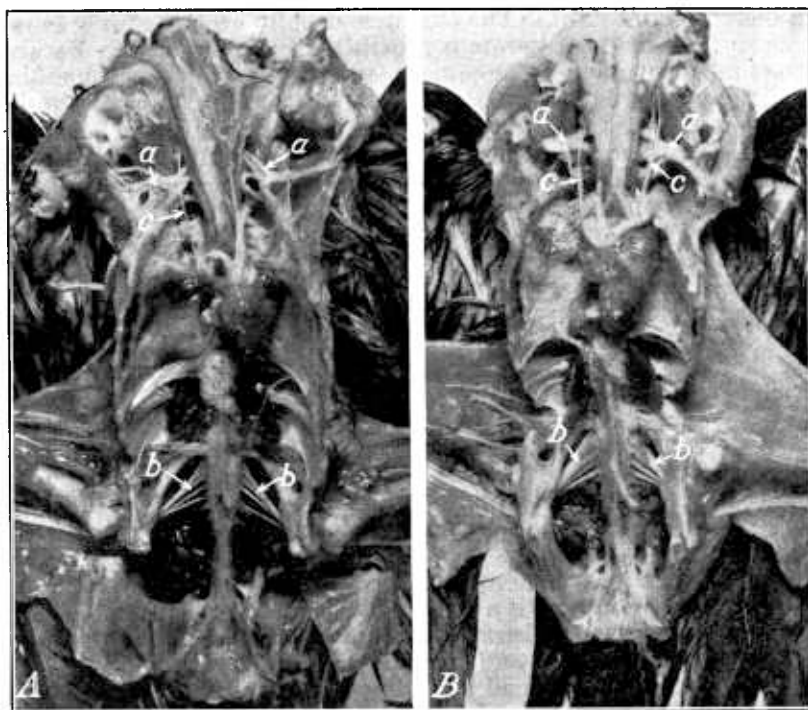
Skin tumors may be small and almost as numerous as the feather follicles, or there may be only a few large ones (1 inch or more in diameter), the centers of which are generally necrotic and discharging.

Anemia may be recognized by the extreme pallor of the head or by microscopic examination of the blood. If it is a true leukemia, the leucocytes, or immature blood cells, will be present in the blood in large numbers. This is the only type of the fowl-paralysis complex in which there is obvious alteration of the blood picture.

Acute attacks may terminate fatally in a few days, whereas birds affected with the chronic form of the disease may live for weeks or months; a few appear to recover.

Post mortem appearance.—On autopsy of the paralyzed fowls it will be noticed that the nerve supplying the affected limb is swollen (fig. 10). The part of the nerve in which the swelling is most prominent is generally the first inch after its emergence from the spinal column, though sometimes the swelling is apparent all the way down the leg or wing to the nerve ending. It is usually necessary to remove the overlying kidney to observe the enlargement of the lumbosacral nerve plexus. The vagus nerves (fig. 10, cc), supplying the heart, lungs, and digestive tract, may show only spindle-shaped swellings just anterior to the heart, or uniform enlargement all the way to the head.

In the acute form of the disease which attacks young birds on the range the victims may be in good flesh, and post mortem examination usually shows nerve enlargement, or tumor formation, frequently of the ovary. In the more chronic form of the disease the birds generally show extreme emaciation with atrophy of the internal organs, and diffuse hemorrhages in the muscles giving the flesh a dark red, mottled appearance.



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FIGURE 10.—*A*, Carcass of a fowl showing normal nerves (left vagus nerve not shown); *B*, carcass of a fowl dead of paralysis; *aa*, brachial nerves to wings; *bb*, lumbosacral nerves to legs; *cc*, vagus nerves to heart, lungs, and digestive tract. Note swollen nerves in carcass of fowl dead of paralysis.

Tumor formation (lymphocytoma) is a common lesion in paralysis-infected flocks and may be found on the skin or in the internal organs. The liver is frequently the seat of either diffuse or nodular tumor formations which may cause enormous enlargement of this organ up to 200 grams or more. This is commonly called "big-liver disease," or leukemia. However, it is not a true leukemia as an abnormal number of leucocytes is not observed on examination of the blood. The ovary, kidneys, heart, lungs, spleen, digestive tract, or any other tissue may be the site of tumor formation. These tumors are firm and fleshy in consistence and white or gray in color. In the nodular type the tumor may vary from the size of a pinhead up to that of a hen's egg. In the diffuse type of tumor the organ involved is enlarged, firmer in consistence than normal, and usually shows a mottled gray discoloration instead of the normal pink or red.

Mode of transmission.—There is considerable evidence that this disease is spread by contact with infected birds and with contaminated surroundings. Field and laboratory investigations also furnish some evidence of transmission through the egg.

Control.—General measures consist in the elimination of sick birds and sanitation, as in any other infectious disease. Remove all sick birds showing lameness, droopy wings, gray eye, severe loss of flesh,

pronounced paleness of the head, and large tumors on the skin. Clean and disinfect the laying quarters, runways, and utensils. Prevent birds from contaminating the feed and water supply.

In addition to the above-mentioned sanitary procedures the only other measures which aid in controlling the disease are breeding for resistance and depopulation. None of these control procedures, however, will be found completely satisfactory.

In breeding for resistance the healthy survivors of an outbreak of the disease are retained for breeders. Hatch eggs from these survivors, preferably from 2-year-old hens or older, and use your own incubator. Brood all chicks as far removed as possible from the mature birds. If possible, provide different attendants for the young chicks and for the mature fowls. The young pullets should be provided with clean and disinfected laying quarters separated from the old flock.

Depopulation consists of disposing of the entire flock in which an outbreak of paralysis has occurred, and replacement with new stock. However, this procedure is dangerous as no assurance can be given that the new stock, whether baby chicks or laying fowls, will be free from the disease unless they are obtained from a proved resistant flock, and such flocks are at present hard to find.

Epidemic Tremor (Infectious Avian Encephalomyelitis)

Epidemic tremor (infectious avian encephalomyelitis) is an infectious and contagious disease of young chickens caused by a filtrable infective agent. Older birds may in some instances be affected with this disease.

Course.—In outbreaks of this disease, as many as 50 percent or more of the chicks may be affected, although not all affected chicks die. Some appear to recover, and others continue to manifest the tremor symptom to some extent. These fowls may mature to achieve a relatively normal egg production. Nevertheless, chicks which survive the disease in its acute form and regain normal condition should be finished off as broilers or fryers at an early age, as they may, if allowed to mature, become carriers of the infection. Not every hatch may be affected, since the disease may soon cease to occur or may recur sporadically during the hatching season with variable degrees of mortality. The disease is not known to occur in other species under natural conditions.

Symptoms.—In chicks up to about 2 weeks of age the first symptom usually noted is sluggishness of movement with a progressive incoordination of the gait. With the increased inability to move, the chick develops a weakened cry. Tremor symptoms (shaking of the head and quivering of the wings) usually appear at about this stage of the disease, frequently accompanied by complete helplessness of the chick, which may perish for lack of food or drink or may be trampled to death by the other birds. The rate of violent deaths is enhanced by reason of the irresistible drowsiness which attacks many of the affected chicks.

Transmission and Control.—Epidemic tremor is ordinarily transmissible in the brood by direct contact. Transmission also possibly occurs in the incubator. It has been suspected that the infection may be transmitted by the hen to its chick through the

egg. Chicks taken from infected incubators and sold to remotely located purchasers may subsequently develop the disease and disseminate it among other susceptible chickens. Chicks or hatching eggs should, therefore, be obtained from sources known to be free of the disease. Susceptible stock should not be allowed contact with affected or apparently recovered chicks or hens. It has been reported that some strains of chickens are more susceptible than others. If the disease is promptly diagnosed in a brood, the affected individuals should be removed to isolated quarters or destroyed. Sanitary measures in the incubation of eggs and the brooding of chicks should be carried out, as discussed under the headings Disease Prevention, Disease Control and Eradication, and Pullorum Disease of this bulletin. There is no medicinal treatment known for the prevention or cure of epidemic tremor.

DISEASES CAUSED BY FUNGI (MOLDS)

Aspergillosis

Aspergillosis is a fungous disease of the lungs and air sacs which may affect any of the domestic birds and is quite prevalent in birds confined in zoos or other aviaries. It is regarded as one of the causes of brooder pneumonia in baby chicks.

Cause.—The causative agents are the common green mold (*Aspergillus fumigatus*) and the black mold (*A. niger*) which grow on vegetables and other kinds of matter. Warmth and moisture favor their development. When moldy hay, straw, or chaff is given to the fowls to scratch in, or moldy grain is fed, the spores of the fungi are inhaled by the birds.

Symptoms.—This disease may be limited to a single bird, or it may assume the form of an extensive outbreak among adult fowls. Occasionally it may cause a brooder pneumonia among chicks, but this should not be confused with brooder pneumonia due to pullorum disease. When the air tubes or lungs are attacked, the first symptom is a slight catarrh, with accelerated breathing. Soon the swellings obstruct the passage of air, and there is a rattling or croupy sound heard chiefly during expiration. The affected birds mope, separate themselves from the remainder of the flock, or remain in a sitting posture; if made to move, they appear weak and scarcely able to walk, and if they try to run they soon fall from exhaustion. The difficulty of breathing increases rapidly; they gasp for breath and make movements of the head and neck as if choking; there are fever, diarrhea, drooping wings, great depression, a tendency to sleep, and finally suffocation and death.

When the disease is limited to the large air sacs the only symptoms are weakness and progressive loss of flesh. If the small air sacs of the bones are involved there may be lameness, with swollen and inflamed joints. The symptoms in brooder chicks are similar to those of pullorum disease. Aspergillosis is always fatal. Young chicks die within a few days. Older birds may live from 1 to 4 or more weeks after the appearance of symptoms.

Post mortem appearance.—The walls of the windpipe, air passages in the lungs, and air sacs in the body cavity show whitish or yellowish nodules in the early stages of the disease. Later the walls are covered by elevated, dirty-yellow, or greenish layers, which

represent growths of the mold, and the air sacs may become completely filled with firm yellow pus.

Prevention.—The disease is prevented by giving only clean and bright straw or chaff for the fowls and brooder chicks to scratch in, by keeping the houses and yards clean, and seeing that all grain and meal fed are sound and entirely free from mold. The sick birds should be removed from the flock, and the bodies of those which die should be burned or buried.

Thrush

Thrush is an infectious disease of the mouth and crop, and sometimes of the esophagus and glandular stomach, of young chickens, pigeons, turkeys, and geese. The disease is caused by the fungus *Oidium* (*Saccharomyces*) *albicans* and is manifested by the formation of grayish-white or yellowish patches on the mucous membranes of the parts named. These patches may eventually enlarge and coalesce. A slimy discharge may drool from the mouth of the affected bird. Loss of appetite and consequent weakness and emaciation attend the disease.

Treatment.—The sick birds should be isolated. The visible thrush deposits in the mouth and throat cavities should be removed with forceps, and the erosions painted with glycerin-iodine solution (tincture of iodine, one part; glycerin, four parts). If the crop is affected it may be flushed out with a 2-percent boric acid solution. The quarters and equipment should be cleaned and disinfected.

Favus (White Comb)

Favus of fowls is a contagious disease that begins with the formation of grayish-white spots on the comb, ear lobes, or wattles.

Cause.—This disease is caused by a fungus called *Lophophyton gallinae* and is transmitted from fowl to fowl by simple contact.

Symptoms.—Favus generally begins on the bare parts of the head as small, white, or grayish spots, which increase in number and size until the whole surface is covered with dry, scaly, dirty-white crusts with an irregular surface. As the disease advances the neck and body are gradually invaded, and the feathers become brittle and break off, leaving a deep depression in the center of a cup-shaped disk. The disease when limited to the comb and wattles may disappear without treatment, but after it has invaded the feathered parts it almost invariably continues to advance, and the birds grow weaker until they die.

Treatment.—When only the bare parts of the head are affected, the disease may be cured by daily applications of tincture of iodine to the diseased areas. It is essential to separate the affected bird from the flock. If the feathered parts of the body are affected, it is advisable to kill the bird.

DISEASES OF THE DIGESTIVE ORGANS

Impacted Crop (Crop-Bound)

The affection known as impacted crop or crop-bound is an over-distended and paralyzed condition of the crop, generally caused by

overeating or by swallowing coarse and indigestible substances, such as feathers, or fibrous feeds, especially straw. In fowl cholera and some other diseases, the crop is paralyzed as a result of the disease.

Symptoms.—The first symptom is a loss of appetite, or an effort of the bird to swallow without being able to do so. The crop is very large and much distended, with contents more or less firmly packed together. If permitted to continue, the condition becomes aggravated, breathing is difficult, and death may result.

Treatment.—The contents of the crop may be removed sometimes by forcing the bird to swallow a teaspoon or more of sweet oil and massaging the lower part of the gullet, if it contains feed, or if not, the part of the crop nearest to the gullet, until the contents are softened and may be pressed toward the head. This is made easier by holding the bird head downward. By continued manipulation the greater part of the material may be removed. The bird should not be permitted to eat for several hours after it is relieved. If this treatment is not successful, the crop may be opened with a sharp knife and the contents removed through the opening, a coffee spoon, a button hook, small forceps, a bent wire, or other suitable instrument being used for this purpose. Then wash out the crop with clean, warm water. The opening should not be more than an inch in length and should be closed with three or four stitches, first in the wall of the crop and, when this is finished, by an equal number in the skin. Each stitch should be made and tied separately. Coarse, white silk is the best material, but if it is not available ordinary cotton thread may be used. Feed the bird for a day or two on milk and raw egg, beaten together, and gradually change to soft mash.

Inflammation of the Glandular Stomach (Proventriculitis)

Inflammation of the glandular stomach is often seen in growing chicks reared in confinement, and occasionally in adult fowls.

It is generally due to dietary deficiency or some debilitating disease. It is characterized by a thickening of the wall so that the glandular stomach takes on a globular shape. The lining mucous membrane usually shows various stages of inflammation, ulceration, and atrophy of the digestive enzyme-secreting glands. This glandular atrophy results in poor digestion and emaciation.

This condition can be definitely diagnosed only on autopsy, but if chicks show emaciation in the absence of any other apparent cause, proventriculitis should be considered.

Inflammation of the Intestines (Enteritis)

Enteritis is an inflammation of the lining (mucous) membrane of the intestines. It is not a distinct disease but results from some other condition, such as malnutrition, infectious diseases, or the presence of internal parasites.

This inflammation may vary in degree from a mild catarrh in which there is an excess of mucus and pus in the intestine to a severe hemorrhagic type in which there is capillary hemorrhage into the lumen and the intestinal contents are bloodstained. In severe chronic cases ulcers or erosions of the mucous membrane may develop so that digestion and assimilation of food are seriously interfered with and

poisons are absorbed into the circulation. In other cases irritating substances in the diet may cause diarrhea.

Treatment.—This consists in diagnosing and treating the condition that caused the inflammation. If malnutrition is the cause, the diet should be balanced with proper feed, which should contain adequate amounts of the vitamins. All injurious and irritating substances such as sand, straw, or shavings should be removed when there is a tendency to depraved appetite. If parasites are the cause of the inflammation, measures should be taken to eliminate them. In most cases of enteritis medication is not advisable.

White Diarrhea of Chicks

White diarrhea is a commonly used term which covers various diseases of chicks from the time of hatching until the birds are approximately 1 month old. It merely indicates a common symptom, a whitish diarrhea, which is usually observed in sick chicks, no matter what the specific nature of the disease may be.

Cause.—Aside from specific infections which are discussed elsewhere in this bulletin, the principal cause of white diarrhea is a non-specific fever accompanying colds, chilling, overheating, or intestinal disturbance from incorrect feeding or insanitary quarters.

Symptoms.—The disease may run a mild and transitory course, or it may progress in severity with aggravated symptoms approaching those of pullorum disease, which is described elsewhere in this bulletin.

Treatment.—Medicinal treatment of affected chicks is impractical. Corrective treatment consists in practical measures to remove the cause or causes indicated, and in general to secure, for the brood, clean and comfortable living conditions, including proper feeding, watering, and ventilation.

Indigestion

To digestive disturbance may be attributed numerous conditions such as loss of appetite, pica (abnormal or depraved appetite), sour or hanging crop, impaction of the gizzard, diarrhea, and constipation.

Cause.—The principal causes are irregularities of feeding, such as feed that is too coarse, dry, or fibrous, moldy or decayed feed, access to poisonous plants or irritating chemicals, or polluted water supply.

Indigestion may also occur as a symptom of some diseases, such as catarrh of the crop or stomach, enteritis, and parasitism, in which cases special treatments should be given.

Treatment.—The ration should be clean, wholesome, and well-balanced and should be supplemented by a constant supply of insoluble grit. For impaction of the gizzard or constipation, Epsom salts, 1 pound to each 10 quarts of drinking water, may be placed before the flock for 1 day instead of other drinking water; or castor oil, 1 pint per hundred birds, may be fed thoroughly mixed in a moist mash.

Sour or hanging crop may be treated by flushing out the crop with a bicarbonate of soda solution consisting of two teaspoons of the soda to a pint of warm water, in a fountain syringe. Hold the head of the bird down, and empty the crop by gentle pressure, repeating the process daily until the bird recovers. Keep the bird on a soft diet, principally sour milk or buttermilk, for several days after recovery takes place. Following attacks of indigestion, it is sometimes beneficial to

stimulate the appetite and promote the secretion of digestive fluids by the administration of a tonic. A veterinarian can best prescribe the tonic most suitable in a particular case.

DISEASES OF THE REPRODUCTIVE ORGANS

Inflammation of the Egg Duct (Salpingitis)

Inflammation of the egg duct is characterized by a whitish diarrhea and a creamy discharge from the egg duct which soil the feathers around the vent and cause redness and irritation of the skin. Other birds attack the affected individual, severely lacerating the posterior parts and in a short time disemboweling the victim.

The sporadic occurrence of bloody eggs, stinking eggs, misshapen eggs, yolkless eggs, eggs with blood-smeared shells, soft-shelled eggs, egg-bound, etc., may at times be traceable to isolated cases of salpingitis and may even be the forerunner of a general outbreak of the disease. Some outbreaks of salpingitis are traceable to infection with *Salmonella pullorum*. Many cases of peritonitis caused by the internal rupture of infected egg yolks may be variations of this disease.

Treatment.—When only a few birds are affected, relief may be afforded by douching the egg duct with a one-half of 1-percent solution of creolin. Segregating the visibly affected birds, thus protecting them from attack by others, should increase the number of recoveries. Male birds should be kept away, as they may spread the infection to healthy hens through breeding activity. This condition often occurs, however, even in virgin pullets, without reference to the activities of the male.

In outbreaks of salpingitis which may be traced to *Salmonella pullorum* infection it would be unwise to use for breeding purposes any birds which had been affected, as to do so may cause the spread of pullorum disease in the chicks.

Egg-Bound

The condition known as egg-bound (failure to pass the egg in the normal manner) is of frequent occurrence in fowls, especially in pullets beginning to lay.

Cause.—The difficulty may be due to inflammation, stricture, or tumor formation in the posterior part of the egg passage. Sometimes malformed or double-yolked eggs are responsible. In pullets the usual cause is the attempted passage of a large-sized egg before the egg passage has become sufficiently dilated to accommodate it.

Symptoms.—Affected hens become restless and make frequent visits to the nest in their effort to lay. The straining may cause inflammation and often eversion of the oviduct (egg tube) through the vent. Others of the flock, attracted by the inflamed, protruding parts, peck at them and tear out portions of the egg passage and intestine, causing the death of the hen. If prolapse does not occur, the distressed fowl may continue her efforts to lay until successful or until overcome by weakness or internal hemorrhage from rupture of the oviduct. The egg may be felt by passing the forefinger through the vent.

Treatment.—The surest method of treatment is to remove the egg by the following procedure: Pass the forefinger through the vent.

With the other hand pressing on the abdomen of the fowl force the egg toward the vent, guiding it by the aid of the inserted finger. When the shell is observed through the vent, puncture it with an awl or other sharp-pointed instrument, break it in pieces, and withdraw these and the egg contents. Isolate the bird and inject cold water into the cloaca (the common passage into which the intestine and the oviduct open) to reduce the inflammation. If the oviduct has been everted through the vent, clean and push the parts back and inject cold water frequently until the tissues remain in place.

Vent Gleet (Cloacitis)

Vent gleet is an ulcerative condition of the cloaca of fowls, the cause of which is not known.

Symptoms.—There is inflammation of the cloaca and vent. The skin around the vent is swollen, reddened, and ulcerated, and an offensive odor is usually present. The droppings are foul smelling and liquid, and are frequently voided. Other chicks may peck at the inflamed part and often tear the cloaca and rectum, causing the death of the victim.

Treatment.—The disease is very resistant to treatment. It is usually better to destroy the bird. If treatment is desired, 3-percent silver nitrate solution may be applied to the mucous membranes of the cloaca by means of a cotton swab, or 2-percent carbolic ointment may be applied daily over the affected area. Repeated application of a 3-percent solution of chromic acid, by gently bathing the affected area once every 3 or 4 days has been reported as beneficial in this disease.

ENVIRONMENTAL DISEASES

"MUSHY-CHICK" DISEASE (OMPHALITIS, NAVEL INFECTION)

This condition is characterized by the death of the affected newly hatched chicks in the incubator. The tiny carcasses are found in a soft condition flattened against the floor of the hatching trays. An extremely offensive odor is present.

Mushy-chick disease is thought by some investigators to be due to a possible combination of insanitary hatching conditions and possibly an excess of humidity in the incubator at hatching time which prevents the closing of the navel after the yolk sac has been drawn into the body cavity of the chick. Bacteria of various kinds gain entrance into the umbilical opening and set up the infection resulting in the death and softening of the chicks.

The prevention of this condition lies in the proper cleanliness and sanitation about the hatchery. Procedures recommended under hatchery sanitation in the control of pullorum disease on page 12 are equally applicable in combating mushy-chick disease.

CARBON MONOXIDE POISONING

Young birds must have abundant fresh air to maintain health and promote growth and development. Brooder houses heated by open fires, gas, wood, coal, or oil burners may develop dangerous gases unless sufficient oxygen is present in the air to support normal combustion.

Provision must be made for the proper intake of fresh air and a corresponding outlet for foul air.

In poorly ventilated brooders deadly carbon monoxide gas sometimes accumulates. Very small quantities of this gas will kill a chick or poult in a short time, especially during a cold night or stormy weather when the minimum of fresh air is usually provided. Overcrowding and too high temperatures increase the chances of gassing in badly ventilated brooders.

The chief symptoms of acute gas poisoning are stupor, drowsiness, labored breathing, a wobbling gait, and spasms. In subacute cases the appetite is poor, the feathers rough, the birds are stunted, and additional evidence of lowered vitality may be seen. Measures to prevent losses from noxious gas include the use of electric heaters, or hot-water heating devices with the boiler entirely outside the brooder house. When other types of heating are used, special care should be given to proper ventilation for both the normal operation of the stoves and for the comfort of the young birds that are being brooded.

BREAST BLISTERS

The occurrence of blisters on the skin of the breast of chickens is of considerable economic importance to the industry, for the reason that breast blisters constitute a serious blemish from the standpoint of marketability of poultry for food purposes.

The problem occurs principally in battery-reared birds and is probably due to a combination of circumstances. Birds that are fattened at an early age have a tendency to rest their weight by sitting a good deal of the time in a recumbent position on the battery floor. Sometimes the feeders are placed so low outside the batteries that the larger birds find it necessary to crouch in order to eat. The irritation of the wire floors or rough or dirty roosts on the tender skin of young or fast-growing birds is likely to produce breast blisters.

Prevention.—Breast blisters may be prevented to some extent by such changes in the system of management as will tend to keep the birds from resting on their breasts. Even on wire floors abundant clean litter may be provided that will protect their skin from the rough metal. The mash troughs may be elevated and the portholes adjusted so that the birds may eat in a standing position. Rough or dirty roosts should be replaced.

MISCELLANEOUS DISEASES AND CONDITIONS

TUMORS

A number of varieties of tumors occur frequently in birds. The largest percentage is found in fowls more than 2 years old. In hens the egg organs are affected in more than 50 percent of the cases. Tumors in birds have a marked tendency to break down and cause death from internal hemorrhage. Tumors on the skin are easily recognized while internal ones may be suspected when an individual in the flock shows poor condition, increasing droopiness, or emaciation.

Treatment.—There is no treatment for internal tumors. External ones can be removed satisfactorily in some cases by surgical means. Since many of the growths, however, are of a malignant or cancerous nature, it is best to kill the bird and destroy the carcass.

ARTHRITIS (INFLAMMATION OF THE JOINTS)

This is an inflammatory condition surrounding the joints of the legs or wings of chickens, turkeys, pheasants, pigeons, young ducks and geese, and other species, causing lameness of the affected member.

Cause.—The disease is caused by a micro-organism known as *Staphylococcus aureus*, which multiplies in the region of the joints. In young ducks or geese the disease may assume an acute character, causing death in from 2 days to 2 weeks. Survivors may gradually recover. In acute cases there are general depression, diarrhea, and discharge from the eyes. In chronic cases the general symptoms are less marked, but emaciation is pronounced. In either type characteristic symptoms are lameness and swelling of the affected joints. The swellings are hot and painful. The bird lies on its breast with legs extending backward and, if forced, can move only a short distance by flapping its wings. Sometimes the wing joints are swollen and the wings droop. In young ducks and geese especially the intestine may be inflamed, with slimy reddish contents, and the liver and spleen may be enlarged. The affected joints are red, swollen, and surrounded with yellowish fibrous or cheesy exudates.

Treatment.—Acute cases do not respond favorably to treatment. The joints should be painted daily with tincture of iodine. Isolate the affected birds, and keep the houses and utensils clean and disinfected. The birds should not have access to stagnant water. Clean feed and water should be provided.

This disease should not be confused with the lameness caused by gout, perosis, fowl cholera, paratyphoid (in pigeons), fowl tuberculosis, paralysis, or bumblefoot, which are discussed elsewhere in this bulletin.

BUMBLEFOOT

Bumblefoot is a term applied to a swelling of the foot in fowls.

It may result from bruises or from cuts or punctures of the skin of the foot, which becomes infected by germs. The invading organisms set up an inflammation with the formation of fluid or cheesy, suppurative material, in the ball of the foot, in the spaces between the toes, or in both locations (fig. 11). Recent investigations have shown that in many cases of bumblefoot an organism is present which resembles that of fowl tuberculosis.

Treatment.—In some cases the application of tincture of iodine to the swollen area daily for several days will bring about recovery. If the swelling is hot and has the appearance of an abscess, it should be lanced and the contents washed out. The interior of the abscess is then soaked with 5-percent carbolic acid or tincture of iodine and the



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FIGURE 11.—A typical case of bumblefoot in a chicken.

foot bandaged. The fowl should be placed in a small compartment without a perch and the wound disinfected daily for several days.

SUBCUTANEOUS EMPHYSEMA (AIR UNDER THE SKIN)

Subcutaneous emphysema is a condition in which the skin of the breast and other parts of the body is distended by air, and thus separated from the underlying tissues of the bird's body. This gives the bird a peculiar puffed-up appearance. The inflated condition of the skin is immediately detected by handling the bird. Chickens, pigeons, and turkeys are susceptible to the condition.

Cause.—It is probable that subcutaneous emphysema is ordinarily caused by a rupture of one of the air sacs of the body, or other respiratory organs, which permits a leakage of inhaled air into the spaces immediately beneath the skin.

Treatment.—No medicinal treatment for the condition is known. Relief may be afforded by slitting the skin over affected areas; thus allowing the accumulated air to escape. Some cases may be reduced by exerting prolonged gentle pressure over the distended portions of the body of the bird, and in this way forcing some of the air out through the same avenue by which it gained entrance into the subcutaneous region.

LIMBER NECK (BOTULISM)

The condition known as limber neck is a symptom of several diseases, among which are botulism or other food poisoning. It is characterized by a paralysis of the muscles of the neck, which makes it impossible for the bird to raise its head from the ground. This condition is due to the absorption from the crop or intestines of poisons which act on the nervous system and cause paralysis. It is generally associated with the eating of spoiled feed or putrid meat in which certain poison-producing organisms are growing, or of fly maggots which have bred on such material.

Treatment.—The best treatment is to give a full dose of purgative medicine—that is, one-half teaspoonful of Epsom salts, or three or four teaspoonfuls of castor oil for a grown fowl. Unless treatment can be given very promptly there is little hope of saving the bird. Spoiled canned goods should not be fed to chickens. Carcasses of fowls or other animals should be burned or deeply buried as soon as found.

ROSE CHAFER POISONING

Rose chafers, or rose beetles, are extremely poisonous to chickens under 10 weeks old. They are found in the Atlantic Coast, Middle West, and Central States. When these beetles are on vegetation, chickens devour them readily, and only a few are necessary to cause death.

Symptoms.—Signs of poisoning may appear as early as 1 hour after feeding on the chafers, and death may follow in 1 hour after the appearance of symptoms. If sufficient poison is not absorbed to cause death, the bird recovers. The affected chicken becomes drowsy, shows weakness of the legs, and falls over on its side. There may be convulsions. Sharp cries are frequently emitted, and the head and neck are retracted over the back of the bird. The only evidence of the disease is the presence of rose chafers in the crop.

Treatment.—The rapid action of the poison renders treatment futile in birds showing symptoms. When the nature of the trouble is realized, other birds in the flock which had opportunity to eat chafers should be given Epsom salts in the proportion of one-fourth of a teaspoonful, mixed with a small quantity of feed, to each bird. Preventive measures consist in keeping young chickens in enclosed runs or at points where they will not have access to grapevines, rose-bushes, and shrubbery when the insects are prevalent. This corresponds somewhat closely to the time of first blossoming of the various garden flowers. Destruction of the beetles should be practiced by spraying infected plants with one-half to three-fifths of a pound of lead arsenate to 10 gallons of water.

SALT POISONING

Chickens, turkeys, pigeons, and other species of fowl are susceptible to poisoning by common salt when large quantities are consumed at one time. Ordinarily, from one-third to one-half ounce of salt would be a fatal dose for the average chicken. Care should be taken not to leave fish brine, freezing brine, or ice-cream salt within reach of the fowls, as they may swallow sufficient quantities of the material to poison them.

Symptoms.—This form of poisoning is manifested by progressive paralysis-like symptoms accompanied by extreme drowsiness and finally death by asphyxiation due to the weakening effect of the poison upon the muscles of respiration.

Post Mortem Appearance.—The mucosa of the mouth is covered with a dirty viscid exudate. Evidences of congestion and ulceration appear on the mucous membranes of the esophagus, crop, and intestinal tract. The internal organs and nerve centers are more or less congested, and the blood possesses a peculiar bright red coloration.

Treatment.—There is no medicinal treatment for salt poisoning of poultry.

PARASITES AND PARASITIC DISEASES

A number of different kinds of parasites found in poultry in the United States may seriously affect the health of the birds. These parasites may be divided into three general groups. One group, known as Protozoa, consists of organisms so small that they can be seen only with the aid of a microscope. The second group consists of worm parasites, of several kinds, all but a few of which are sufficiently large, when full-grown, to be seen with the naked eye. The third group is made up of small, parasitic arthropods, namely, certain insects (including lice and fleas), and certain mites, which include not only mites as commonly known but also ticks. The location of parasites varies greatly with the different kind of parasites; protozoa may occur in the blood stream, in the kidneys, and in the intestines of certain domestic birds; worm parasites may occur in such varied locations as the eye, the windpipe, all parts of the digestive tract, the reproductive organs, and in or under the skin; and arthropod parasites of poultry occur chiefly on the outside of the body, either on the feathers or in or under the skin, but, on the other hand, in the case of certain mites, may occur within the body, in the air passages, lungs, and liver.

METHOD OF EXAMINING FOWLS FOR PARASITES

An examination of a domestic bird for the purpose of determining whether parasites are present must take into consideration these differences in the kinds of parasites and their possible locations.

A careful examination of the skin among the feathers on various parts of the body will reveal the presence of lice and certain species of mites. Some lice are found on the feathers and some kinds of mites are to be found between the barbules of the feathers or inside of the quills at the base of the larger feathers. The scaly leg mite is

to be found in or just beneath the scales on the shanks or feet and in minute lesions on the comb or wattles. As regards the internal parasites, for locating protozoa, smears or sections made from infected parts of the bird must be examined microscopically. On the other hand, to locate worm parasites and the mites which occur within the body, the various parts of the body may be examined according to some such procedure as the following:

In examining a dead fowl the feathers are removed from the under side, the abdomen is carefully opened along the median line, and the breast is cut loose on each side and turned forward. The various internal organs are then carefully loosened from the tissues which hold them in place, and, after being spread out, as in figure 12, so that they can be separated and identified, they are re-

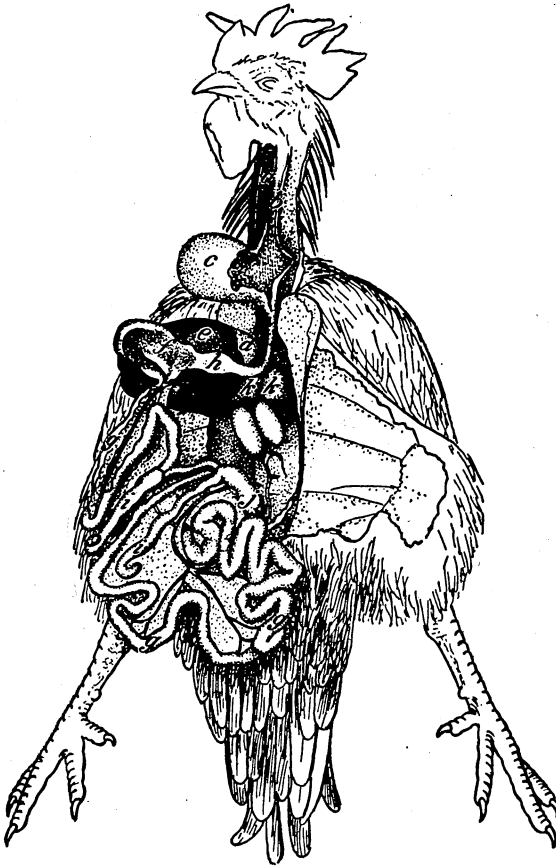


FIGURE 12.—Internal organs of fowl, which have been spread out; *a*, Windpipe or trachea; *b*, undilated esophagus; *c*, crop; *d*, heart; *e*, liver; *f*, gizzard; *g*, intestines; *h*, glandular stomach; *i*, ceca or blind guts; *j*, rectum; *k*, lungs. Adapted from Sunderland.

removed from the bird. The windpipe or trachea (*a*) is cut open and its inner surface examined; the lungs (*k*) are also removed and carefully inspected. The esophagus, including the undilated part, and the crop (*b* and *c*), are slit open and the contents washed into a shallow glass dish and examined; the wall of the esophagus is examined by stretching it between the hands and holding it up between the observer's eyes and

the light so that the light shines through it and thus throws into relief the outline of any worms embedded in the wall. The remainder of the digestive tract, made up of the two stomachs, namely, the glandular stomach (*h*) and the muscular stomach or gizzard (*f*), and the intestines (*g*), is next cut loose and lifted out into a dish of water. The glandular stomach or proventriculus (*h*) is opened and washed into a glass dish, and the glands are squeezed so that embedded parasites may be loosened; the wall is examined on both the inner and outer surfaces, one of the nematodes found in this location, namely, the globular, red tetramere, often showing more clearly through the semi-transparent outer surface than through the opaque inner surface. The muscular stomach or gizzard (*f*) is opened, and its contents are emptied out and examined; the horny lining is then peeled off, and the inner surface of the lining and also the newly exposed surface of the muscular wall are examined for parasites. The small intestine (*g*) and finally the ceca (*i*) are slit open in water, separately; the wall of these organs is run through between the thumb and fingers and examined carefully during the process, in order to remove any parasites which are buried in the mucus or attached to the wall; the intestinal contents may be washed and allowed to settle several times until the water is clear, and then examined in shallow glass dishes.

METHOD OF KILLING AND PRESERVING PARASITES

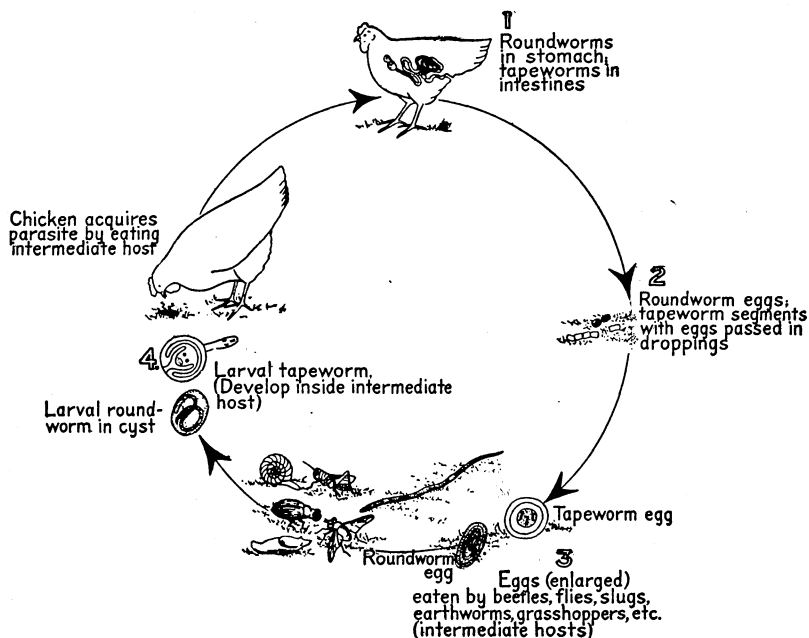
Protozoa can be found to best advantage in fresh material, and certain organisms belonging to this group can be found only in such material. Other protozoa, as the coccidia, if microscopical examination cannot be made of the intestinal contents when fresh, are recognizable on examination if the material is preserved by the addition of formaldehyde solution. Worm parasites which have been collected should be washed well in water in order to remove all mucus or other clinging material, and should then be put into a weak solution of formaldehyde (from 2 to 4 percent), which has been warmed to the point at which it begins to steam. Material of this sort can be shipped to laboratories for identification. Arthropod parasites may be preserved in 2-percent formaldehyde solution or 75-percent alcohol. Proper labeling of preserved specimens is important. The age, breed, and other facts about the host, location within or on the fowl, the locality, date of collection, and collector's name should be given.

VARIOUS METHODS OF REPRODUCTION AND OF SPREAD OF PARASITES

The different kinds of parasites of poultry have very different life habits. A knowledge of these habits is important in understanding the diseases caused by them and in deciding on methods of checking those diseases. Protozoa, for instance, multiply within the bird's body so that one organism may give rise to large numbers of organisms (fig. 17, A). Worm parasites, on the other hand, do not multiply within the bird's body; a single egg or single young parasite which gains entrance into the body develops into only one worm, and multiplication depends on the eggs or young worms produced by such a parasite; the parasite eggs or young worms must pass out of the body and undergo more or less development on the ground or in such lower animals as insects before giving rise to additional parasites in birds. The life histories of parasitic insects and mites likewise vary widely. Some species, such as lice and scaly-leg mites, remain on the fowls

continuously and are spread mainly by direct contact. Others, such as the common chicken mite, feed mainly at night and spend the greater part of their lives about the roosting places of the fowls.

The development of the various stages outside the bird's body differs greatly in different worm parasites. In some cases there is a direct life history; the parasite eggs which pass out of the body develop within them the young stage of the worm, which on being taken into the body of a bird will infect it and will develop to an adult parasite.



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FIGURE 13.—Diagram of the various stages in an indirect life history of a tapeworm and a roundworm of poultry.

In other cases the life history is indirect; the bird is known as the primary host, and the parasite eggs which pass out of its body must go into one or more intermediate hosts before again going back to a bird. An example of such an indirect life history is given subsequently with reference to one of the flukes found in birds. In the cases of indirect life histories of tapeworms and roundworms, only one intermediate host is necessary, so far as is known; the nature of the intermediate host may vary and is still unknown for some parasites, but in certain instances insects, snails, slugs, and earthworms have been found to serve in this capacity. Figure 13 gives in diagrammatic form the various steps in such a life history.

GENERAL MEASURES FOR THE CONTROL OF PARASITES OF POULTRY

Poultry houses and yards should be so placed that rain water will not wash from one to another. Marshy places should be drained, and holes in which water may collect should be filled in. Even if

permanent quarters must be used to some extent, a rotation of yards is highly desirable; the ground should be plowed under and then planted to green stuff when the yard is not in use.

Roosts and nests should be constructed so that they can be readily examined and treated for mites, ticks, and bedbugs. Such arrangement also facilitates thorough cleaning and disinfection for diseases and internal parasites. Keeping under control flies that may carry poultry diseases or internal parasites is important. This is accomplished by preventing flies from breeding in manure and by using fly traps and sprays.⁸

As the most severe damage from parasites occurs in young birds, special precautions should be taken to protect the young. They should be raised away from the older birds, which are often carriers of parasites, and from the infected areas occupied by older birds.

As regards sanitation, feed and water should be given in containers which will not allow contamination of the contents with the birds' droppings. The frequent removal and disposal of droppings are likewise important preventive measures. Disposal should be effected by a method which will keep the droppings with their content of worm eggs and protozoa not only from the chickens but also from the intermediate hosts of the parasites and from wild-animal life which may serve as carriers in one way or another. It is advisable to keep yards free from boards and miscellaneous objects, since they may harbor such intermediate hosts or carriers. Filling in or draining low, damp areas which may breed such intermediate hosts, and the screening of houses are also of value in this connection. A screen, to be effective, should have a mesh small enough to keep out even such small insects as the smaller dung beetles.

The practice of using chicken manure as fertilizer is dangerous from a poultry standpoint, if the manure is spread in places where chickens will have access to it or in places where small animal forms may feed on it and may serve as intermediate hosts or as mechanical carriers to convey parasites back to the poultry. The danger is lessened if the chicken manure is stored in a manner that causes it to heat. The development of heat in the chicken droppings during storage tends to destroy worm eggs and other harmful organisms. Lack of oxygen also aids in this destruction.

A method of storage for horse manure which produces sufficient heat to destroy worm eggs has been worked out by the Bureau of Animal Industry and used with very satisfactory results; this method would probably be applicable to poultry manure. A double-walled, double-floored, wooden box, with sawdust between the double parts of the walls and floors for insulation, and with a tight cover to hold the heat, was found to be the best kind of storage; all parasitic-worm eggs were destroyed in a period of 2 weeks in horse manure stored in this manner. It is a common practice to store chicken droppings in barrels. If the barrels have tight covers and suitable external insulation to hold the heat, droppings which are not dried by the addition of sand or similar material may be expected to heat to the point where parasitic material will be destroyed.

⁸ For information on fly control see Leaflet 182, "Housefly Control," and Farmers' Bulletin 734, "Flytraps and their Operation."

DISEASES CAUSED BY PROTOZOA

Blackhead (Enterohepatitis)

Blackhead is primarily a disease of the ceca and liver, but the fact that the head of the affected bird often becomes discolored has given it its popular name, blackhead. It is most frequently seen as a disease in turkeys, but chickens also are susceptible. Ruffed grouse, bob-white quail, and other gallinaceous game birds likewise have been found to suffer from the disease.

Cause.—The parasite (*Histomonas meleagridis*) causing blackhead is one of the Protozoa. The organisms live part of the time free in the cavity of the ceca, or blind guts, but in another stage of the disease they apparently enter the walls of the ceca and are probably carried through the blood stream to the liver. The organisms in the ceca multiply in large numbers and pass out in the droppings.

Spread of the disease.—Young and adult chickens may contract this disease, but although in some outbreaks they may die in considerable numbers, they more usually recover promptly. However, in spite of their recovery, they remain carriers of the parasites, which are discharged in their droppings in vast numbers. These organisms may infect other birds, either chickens or turkeys, if picked up by them in contaminated feed or water. The realization that turkeys may die, in large numbers, of blackhead contracted from chickens which have the disease in so mild a form as to show no evidence of it has led to strong emphasis being placed on the recommendation that turkeys be kept away from chickens.

It is probable that the parasite which causes blackhead was originally brought to North America in chickens from Europe and that it was passed on to turkeys in this country, thus introducing a new disease to which turkeys were more susceptible than were chickens, which in the course of time had become resistant to it.

Another highly important factor in the spread of the blackhead disease is the part played by the common cecum worm (*Heterakis gallinae*) of chickens and turkeys. The worms in the ceca of a fowl which is infected with the blackhead organisms may carry these organisms in their bodies; the eggs of the worm, which are passed out in large numbers in the droppings of the fowl, carry these small blackhead parasites with them. When the eggs are eaten, in contaminated feed or water, by a fowl and hatch in the intestinal tract the blackhead organisms are transmitted to the bird and set up the disease. The protozoan parasite, being thus included within the shell of the worm egg, is protected from heat, cold, dryness, and other adverse conditions which would otherwise destroy it. The worm eggs, which are resistant to such factors because of their thick shells, can hold the blackhead organisms in the soil from one year to another unless exposed to zero weather, whereas it has been found that the blackhead organism itself, without such protection, seldom survives for more than 24 hours outside the body of the fowl.

Symptoms.—The disease may occur at any time in the life of a turkey, but is most serious in young birds. Droopiness, loss of appetite, an invariable loss of weight, and sometimes a sulfur-colored diarrhea are the main symptoms. The discoloration of the head, which has given the disease its name, is seen also in other diseases and is not always present in this disease, so that the term

"blackhead" is not a very satisfactory term. Death may occur suddenly.

Internal changes.—An examination of the turkey after death shows the ceca, or blind guts, enlarged and filled with a solid, yellowish, cheesy mass which sometimes contains blood; the walls of the ceca may have areas which are roughened and thickened. In addition to the changes in the ceca, the liver is usually affected, it is some-

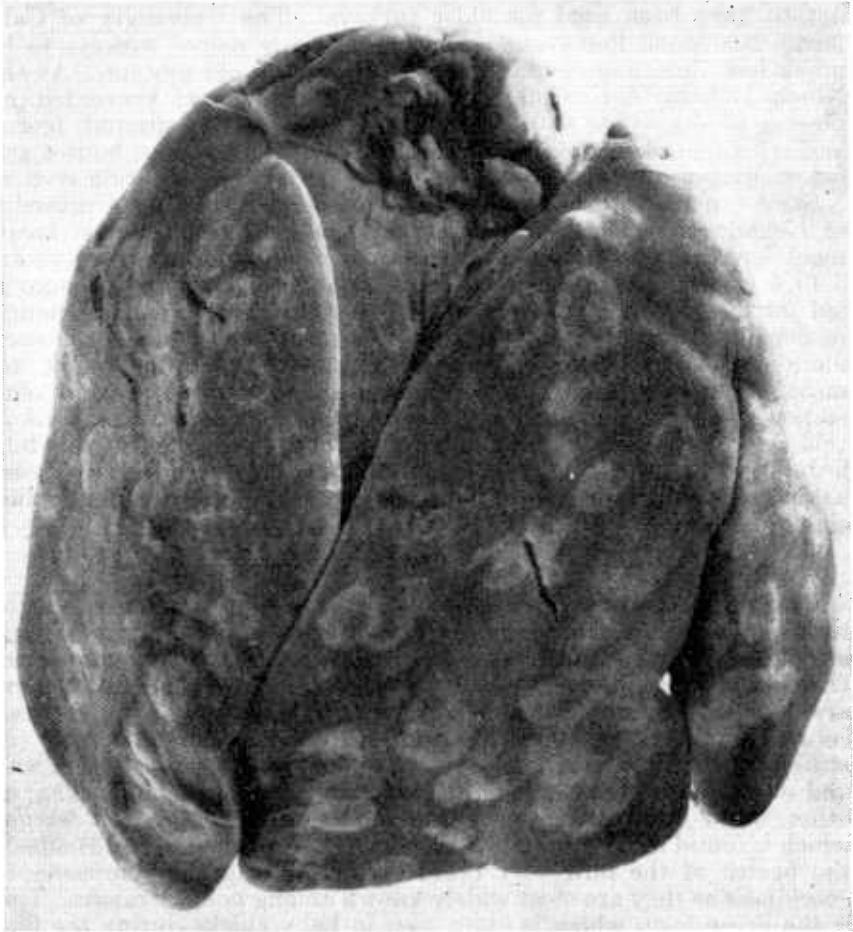


FIGURE 14.—Enterohepatitis (blackhead). Liver of turkey, showing necrotic areas.

times enlarged and often spotted with dark-red, gray, or yellow circular areas, which are usually depressed below the surface rather than raised above it (fig. 14).

Treatment.—Although many drugs have been tried and some are recommended for the treatment of blackhead, none have been found to be of practical use. The only practical, general procedure consists in the use of control measures to prevent the development of the disease.

Prevention.—Since, as explained above, the chicken may act as a carrier of the parasite causing blackhead disease, turkeys should be kept completely removed from chickens or land ranged by chickens or fertilized with chicken manure. In addition the best results are obtained with artificially reared birds—that is, those hatched in incubators and brooded artificially. The poults should be kept first in coops, houses, or runs that can be easily cleaned, and later on pasture that is known not to have been ranged by chickens and preferably not to have been used for older turkeys. The University of California has found losses among such artificially reared turkeys to be much less than among those reared under the old system. At the North Dakota Agricultural College, blackhead was prevented by placing poults, when 6 to 8 weeks old, on a rearing ground, fenced and cross-fenced to provide 4 runs, for monthly rotation; houses and fences are portable and are moved yearly for a 5-year rotation system.

Since cecum worms spread the blackhead parasite, the University of Nevada Extension Service suggests that the tobacco-dust treatment for removal of these worms should begin when the turkeys are 3 to 4 weeks old. Mash containing 2 percent powdered tobacco is fed for 2 days, followed on the third day by Epsom salts, 1 pound in 5 gallons of water or milk; the treatment is repeated once each month until the birds are 5 months old. After each treatment, removal of the turkeys to clean quarters is necessary to prevent reinfection. Losses from blackhead have been considerably reduced in this way. Other treatments for cecum worms are given in this bulletin (p. 71). Any turkeys which show symptoms of the disease should be promptly removed and isolated, and those which have died should be buried.

Coccidiosis

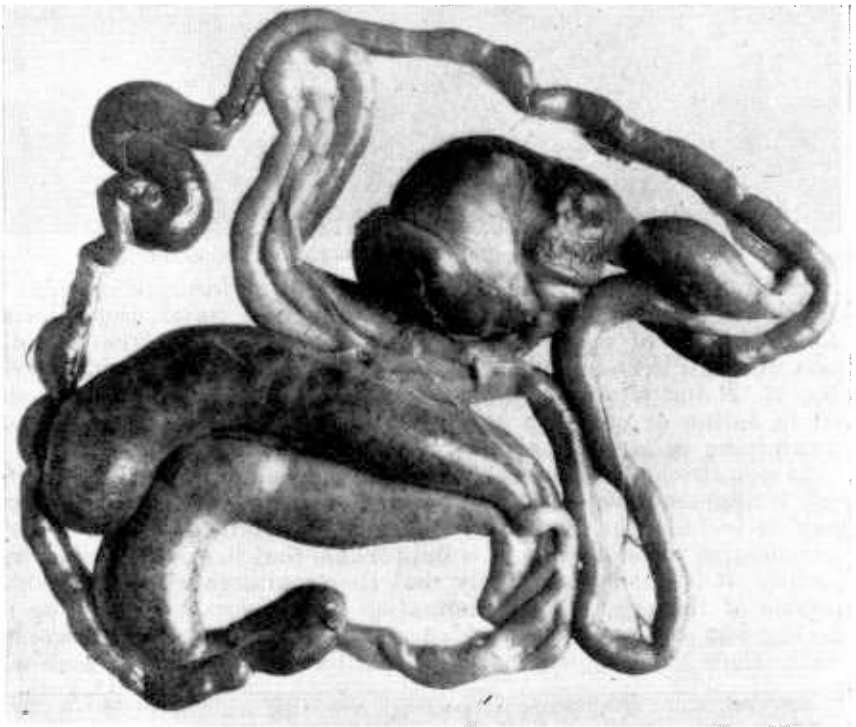
Cause and nature of the disease.—For many years it was thought that minute protozoan organisms known as coccidia, found in a large variety of birds, both domestic and wild, were all the same species (*Eimeria avium*). Recent studies, however, have revealed that there are at least six species of coccidia in chickens alone, the diseases caused by them varying in location and intensity. One species (*E. mitis*) ordinarily produces no noticeable damage to the intestinal wall and does not seriously affect the health or growth of the chicken; at other times it is distinctly injurious. Another species (*E. tenella*) which is found in the blind guts, or ceca, of the chicken (fig. 15) affects the health of the bird very decidedly, producing the symptoms of coccidiosis as they are most widely known among poultry raisers. This is the acute form which is often seen in baby chicks during the first few weeks of life; the coccidia invade the wall of the gut and often produce extensive hemorrhages, blood being noticeable in the droppings. Other symptoms, which in fact may appear earlier than the bloody droppings, are ruffled feathers, pallor, and rapid wasting. Chicks up to 2 months of age may die very suddenly and in large numbers as a result of this form of the disease (fig. 16).

A serious chronic form of coccidiosis may be caused by another species (*E. acervulina*); the organisms in this case live chiefly in the upper part of the small intestine, producing whitish or grayish spots in the wall. Extreme emaciation or wasting of the fowls in severe cases is the principal characteristic of this form of coccidiosis.

Another coccidium (*E. maxima*) occurs in the middle or lower part of the small intestine, producing a thickening of the wall with a variable amount of hemorrhage; however, the quantity of blood passed in the droppings is never so great in this disease as in that involving the ceca. In severe cases of this type, pallor, roughening of the feathers, and diminished appetite result.

E. praecox and *E. necatrix* occur in the small intestine. The latter is pathogenic and produces severe hemorrhage.

Turkeys may be infected with coccidia (*E. meleagridis* and *E. meleagritidis*) species different from those found in chickens. Although outbreaks of coccidiosis occasionally occur in young turkeys, the disease is not yet so widespread or so severe in these birds as it is among chickens. It is probable that the young poults develop an



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FIGURE 15.—Coccidiosis, cecal type. Note the two enlarged, blood-filled ceca, or blind guts.

immunity to the organisms at an early date, as turkey poults may show the presence of these coccidia within the first week after hatching, but may not appear to be injured by them.

Pigeons are also parasitized by one of the coccidia (*Eimeria lab-beana*); the disease produced may be rapidly fatal or may be chronic. In geese, coccidia produce a disease of the kidneys which may weaken them so greatly that they are unable to walk; the birds become progressively weaker until they die. Ducks may suffer severely from an

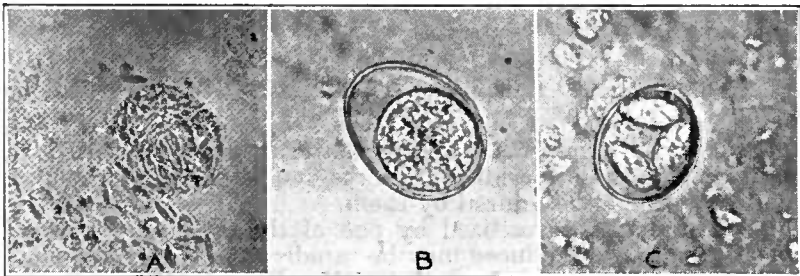
intestinal form of coccidiosis. There is evidence that a species of coccidium is usually limited to one kind of bird.



FIGURE 16.—Chicks suffering from coccidiosis, cecal form.

Method of contracting the disease.—In all forms of coccidiosis the disease is spread by contamination of the feed, water, and soil with the droppings of fowls which harbor the parasites. The coccidia pass through certain stages of development in the outside world (fig. 17, *B* and *C*); later, when taken into the body of a bird in the act of eating or drinking, the organism continues its development, multiplying in large numbers (fig. 17, *A*).

As regards the transmission of coccidia to young birds through the egg, it appears never to have been demonstrated that the organisms may be included in the egg at the time it is formed. Even if such transmission were possible, it is improbable that it would happen frequently; it is much more likely that the organisms would be on the outside of the egg, the contamination of the eggshell occurring as the egg was passing out of the cloaca and vent. However, critical investigations have shown that the coccidia on the eggshell were not



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FIGURE 17.—Various stages of development of organisms which cause coccidiosis: *A*, Manner in which one organism gives rise to a large number of organisms in cecum of fowl; *B*, organism as passed in the droppings of fowl; *C*, organism which has developed to a stage which will infect the fowl. (After Johnson.)

able to survive the incubation of the eggs. It is probable that coccidiosis is contracted by the young chicks much more frequently by other means than by transmission through or on the egg.

The organisms may be carried for considerable distances in running water or in dust, or on shoes, grain sacks, or other objects, or may be spread by birds or by flies or other insects which fly from one poultry yard to another; rats and mice also probably serve to spread the organisms. It has been found that a single organism is capable of producing a mild form of the disease, the organism multiplying in the chick's body and considerable numbers of the parasite later being passed in the droppings, so that as a result the infection is capable of spreading to the other chicks. It is apparent, therefore, that there are many ways in which a small amount of the disease-producing material may be spread.

Post mortem findings.—The changes which will have taken place in the intestines of birds affected with intestinal coccidiosis will depend largely on the species of coccidia present, as noted above. In the acute form of coccidiosis in which the site of infection is in the blind guts, or ceca, these organs usually appear enlarged and filled with blood, and may be plugged with a thick core—a yellowish, cheesy substance with dark bloody areas in it.

Immunity.—There is evidence that chickens which have suffered an attack of coccidiosis are subsequently immune to the species of coccidium that was responsible for the attack but are not immune to other species. There is apparently no such immunity as age immunity, but only immunity following previous infection.

Treatment.—Many treatments have been tried and advocated for coccidiosis, but none have been satisfactory. This may be due partly at least to the fact that instead of one species of coccidium being involved, as was formerly thought, there are several. Instead of placing reliance on medicinal treatment, efforts should be directed toward prevention as outlined below.

Prevention.—Extensive studies of coccidiosis have brought to light two important facts: (1) That the severity of the disease depends on the number of organisms which are taken into the body of the fowl, and (2) that the disease runs a limited course. In nonfatal cases the fowls recover, and the organisms usually disappear within a few weeks, unless reinfection has taken place. Control measures which take these facts into consideration are therefore indicated.

Although there has been little success in the medicinal treatment of coccidiosis after it has fully developed, measures can be taken to prevent the development of the disease in chickens and to reduce its injurious effects if it appears. Strict sanitation, as described below, will reduce the intake of organisms. A well-balanced nutritious diet will help to build up the resistance of the fowls, but is not a cure for the disease.

Daily cleaning is highly advisable, in order that the organisms which are being passed in the droppings may be prevented from developing to the stage which is infective. As a disinfectant for houses, a 2- to 4-percent solution of liquor cresolis compositis or other coal-tar creosotes used in strong, hot solutions is helpful. As the coccidia are very difficult to destroy, cleanliness and the frequent removal of droppings containing the infectious material are highly important, and disinfectants must be regarded only as aids in connection with cleaning up. Coccidia need moisture for their development; hence

thorough drying checks this development. They are susceptible to high temperatures also, boiling water destroying them quickly and hot water of somewhat lower temperature more slowly (a temperature of approximately 130° F. kills them in about 30 minutes). Practical measures based on these principles include: (1) The application of a layer of slaked lime to the ground; (2) putting feeding troughs and drinking vessels into boiling water at frequent intervals; (3) burning carcasses of fowls which have died of the disease; and (4) burning or removing to remote areas the litter or other refuse which may be contaminated with infected droppings.

Strictest precautions should be taken to prevent the contamination of feed supplies while they are being mixed and subsequently while being stored; they should be protected from flies and mice and from the dust of poultry houses or runs.

Rearing chicks on raised wire-mesh floors, through which the droppings will fall, is probably the most effective preventive measure, but birds reared in this way must be kept away from infection subsequently, as they do not have the acquired resistance of birds which have passed through an attack of coccidiosis in early life. Whatever the system of rearing, avoidance of crowding is highly important. The screening of houses and runs in order to keep flies out and thus prevent their spreading the organisms is also of value.

Trichomoniasis

A group of flagellated protozoan parasites, collectively known as trichomonads, are commonly found in the digestive tracts of barnyard fowls; however, only turkeys, chickens, and pigeons have been known to develop symptoms following infection with these parasites.

On the basis of location within the alimentary tract and distinct differences in the pathological pictures resulting from infections, two forms of trichomoniasis in poultry have been recognized, one involving the upper digestive tract and the other the lower digestive tract.

TRICHOMONIASIS OF THE UPPER DIGESTIVE TRACT

Cause.—Owing to the difficulty in classifying the organisms, several different species of trichomonads have been identified as associated with the formation of caseous lesions in the esophagus and crop of domestic fowl. One species (*Trichomonas diversa*) has been reported to be the cause of trichomoniasis of the upper digestive tract of turkeys. Another species (*Trichomonas columbae*) is said to produce lesions in the esophagus and crop of the pigeon. The lesions with which this parasite has been associated are similar to those attributed to *Trichomonas diversa* of the turkey. A third species (*Trichomonas gallinae*) has been identified as the cause of the formation of similar lesions in the upper digestive tract of the chicken.

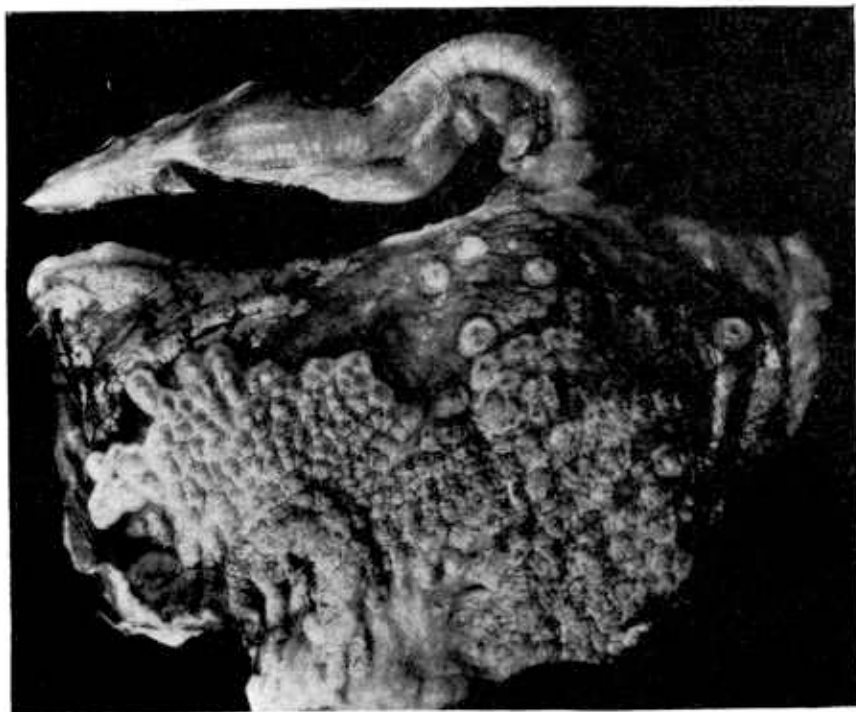
Because of the similarity of location and the results of cross-infection experiments, as well as morphological studies, it has been suggested that the organisms associated with lesions of the esophagus and crop of the turkey, chicken, and pigeon may be the same species (*Trichomonas gallinae*), and that the pigeon may be the source of infection.

Spread of disease.—Infection of new hosts apparently occurs through ingestion of contaminated feed, soil, or drinking water with the parasites which have been discharged from the infected birds in either the droppings or discharges from the mouth.

Symptoms.—Turkeys affected with trichomoniasis of the upper digestive tract are depressed, show a loss of appetite, sagging wings, emaciation, and drooling at the mouth. The droppings are usually watery and contain large numbers of the flagellated parasites. Young birds may die as early as 1 day following the appearance of symptoms, but older birds may linger for several weeks before succumbing. In older birds the region surrounding the crop usually appears depressed and sometimes pendulous. Although certain other diseases may produce similar symptoms, birds that make repeated attempts to swallow and show extension of the head and neck and retention of the crop fluid should be suspected of being affected with this form of trichomoniasis.

Internal changes.—The disease is characterized by the presence of peculiar, cheesy lesions, somewhat resembling those resulting from fungous infection, on the surface of the mucous membranes of the crop and esophagus (fig. 18). In severe infections, the mucous membrane is entirely destroyed. Lesions have never been found in the proventriculus or any organ posterior to it. It has been suggested that perhaps the gastric juice of the proventriculus or glandular stomach may destroy the trichomonads.

Prevention.—Isolation of sick birds, rotation of feeding grounds, clean water and rigid sanitation have been suggested as of value in preventing the spread of the disease. Since adult birds may be carriers of the parasites, the young birds should be kept separated



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FIGURE 18.—Trichomoniasis of the upper digestive tract. Crop showing small cheesy lesions on mucous membrane. (After Bushnell and Twiehaus, 1940.)

from the older fowls. Artificial incubation and brooding, and rearing the young birds on clean ground are recommended.

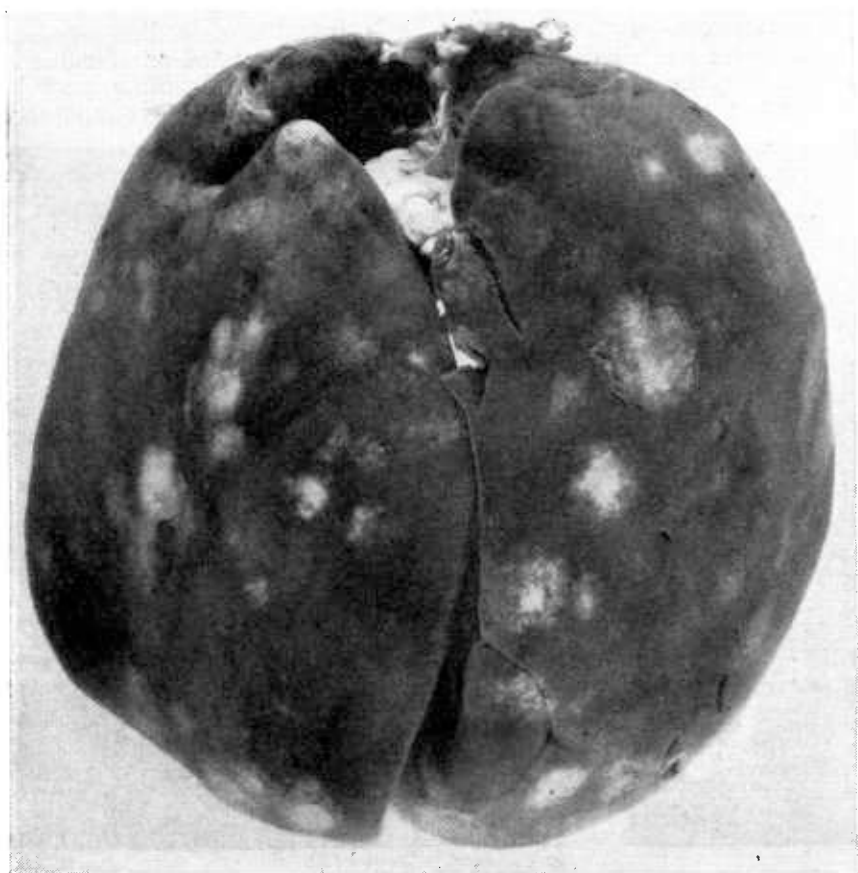
Treatment.—No effective treatment is known.

TRICHOMONIASIS OF THE LOWER DIGESTIVE TRACT

Cause.—Another trichomonad (*Trichomonas gallinarum*) is regarded as the cause of a disease of the lower digestive tract of turkeys, involving the ceca and liver. This protozoan is commonly found in the ceca of turkeys and other barnyard fowl, but only turkeys are known to develop pronounced symptoms following infection.

Spread of disease.—Birds contract the disease through the ingestion of feed, water, or soil contaminated with droppings from infected birds.

Symptoms.—The disease is characterized by diarrhea and occasional deaths in young turkeys; more often, however, symptoms do not appear until the bird is several weeks old. Older turkeys show gradual and progressive evidence of unthriftiness accompanied by droopiness; they frequently develop a persistent diarrhea consisting of liquid, sulfur-colored, foamy droppings. Such birds usually die.



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FIGURE 19.—Trichomoniasis of the lower digestive tract. Liver of turkey showing necrotic areas.

Internal changes.—Young birds may not show any visible lesions. In turkeys 3 months of age or older, the liver is usually covered with irregularly outlined, cream-colored areas of necrosis which appear granular and usually slightly elevated above the surface of the liver tissue (fig. 19). The ceca or blind guts are usually enlarged and filled with yellowish, cheesy masses. The internal changes associated with this type of trichomoniasis are similar to and probably have often been confused with those resulting from the invasion of these organs by the blackhead organism. Moreover, observations have shown that the causative agents of both trichomoniasis and blackhead may be associated in the same liver and even in the same liver lesion (fig. 20).



FIGURE 20.—Liver of turkey showing lesions typifying a mixed infection of trichomoniasis and histomoniasis.

Prevention.—This is similar to that for trichomoniasis of the upper digestive tract.

Treatment.—Birds affected with *Trichomonas gallinarum* have been successfully treated by means of fever therapy. For treatment, the infected birds are placed in a thermostatically controlled box for from 1 to 2 hours, depending upon the condition of the bird. By maintaining an air temperature of approximately 104° F. and a relative humidity of 60 to 70 percent inside the cabinet, the temperature of the bird is elevated 2 to 6 degrees. Treatments are administered every other day until three have been given which are usually sufficient to check the disease. However, six treatments are sometimes necessary in more advanced cases of the disease.

Birds recovering from the disease following treatment behave like normal birds. Post mortem examinations of birds at different times following treatment showed that the liver lesions were either in the process of healing or practically healed.

Although the above treatment has been found to be very effective in treating birds affected with trichomoniasis, it is harmful to birds suffering from histomoniasis or blackhead. Such treatment, therefore, must not be recommended for birds infected with *Histomonas meleagridis*, the causative agent of blackhead, or birds infected with both blackhead and trichomoniasis organisms.

Hexamitiasis, or Infectious Catarrhal Enteritis

Cause and nature of disease.—A protozoan parasite (*Hexamita meleagridis*) has been reported as associated with an internal inflammation of young turkeys in California and elsewhere. The disease which has been designated as infectious catarrhal enteritis is primarily an acute infection of the upper part of the small intestine of turkey poults between the ages of 1 and 12 weeks, with greatest death loss occurring at 3 to 5 weeks. Mortality from acute outbreaks occurs in from 7 to 10 days following the first appearance of symptoms; however, there are occasional deaths for as long as 3 weeks. The death rate varies from 20 to 90 percent.

As the name implies, infectious catarrhal enteritis indicates that the disease is an infectious, intestinal inflammation characterized by abnormally heavy secretion from the mucous glands of the affected intestine.

Spread of the disease.—Infectious catarrhal enteritis is spread primarily by the adult carrier bird. The adult turkey has been shown to be the primary source of infection. The causative agent of this disease has been experimentally transmitted from the turkey to the quail and vice versa, and data are available to indicate that the quail may also serve as a carrier of the infection.

Symptoms.—Affected birds are listless and droopy, walk with a stilted gait, and void watery or foamy droppings. They continue to lose weight in spite of the fact that they continue to eat. If the birds are suffering from an acute infection they may die within a few days after symptoms appear. Lightly infected birds usually survive an attack of the disease, but may become carriers of the organism.

Prevention.—Artificial incubation of eggs is highly recommended to eliminate the possibility of carrier hens transmitting the organism

to young birds at the time of hatching. The brooding quarters must be completely isolated from the breeding quarters in order to reduce chances for acquirement of infection by the young stock. Care should be taken to see that the attendant does not spread the disease on his shoes and clothing. The feeding and watering equipment should be arranged so that the attendant can fill them with feed and water without entering the pens.

Treatment.—No effective treatment has been developed.

Bird Malaria

Several species of birds, including turkeys, ducks, and pigeons are susceptible to malarialike diseases caused by the blood protozoan parasites. These parasites invade the blood corpuscles and so modify the appearance of the host cells that the identity of the latter is completely lost.

TURKEY AND DUCK MALARIA

Cause.—Blood protozoa identified as *Leucocytozoon* spp. have been reported as responsible for considerable losses among turkeys and ducks in the United States. One species (*Leucocytozoon smithi*) has been the cause of losses ranging from 10 to 50 percent of all young turkeys in an affected area; this parasite occurs also in wild turkeys. Another species (*Leucocytozoon anatis*) has been reported as causing tremendous losses among both wild and domestic ducks in the Great Lakes region. These parasites destroy the blood cells of their hosts.

Spread of disease.—Recent studies indicate that blackflies (*Simulium* spp.) are necessary for the successful transmission of the parasites from one bird host to another. These flies ingest the parasites while sucking blood. In the engorged blackflies, the leucocytozoa multiply and, within a few days, reach the infective stage. When these infective stages of the organisms are introduced into susceptible hosts they parasitize the blood corpuscles.

Symptoms.—The general symptoms are common to both kinds of birds regardless of the species of organism causing the disease. In young birds the disease strikes suddenly, with acute symptoms lasting only 2 or 3 days. Affected birds lose appetite, become droopy, and have a tendency to lie down. Birds in the final stage of the disease move with difficulty and, if unduly excited, may fall over into a coma and die. Birds naturally recovering from the disease may remain carriers of the organisms for several months and are a source of infection for other birds. Infected male birds rarely strut, and pay little attention to the females.

Internal changes.—The liver is usually enlarged, with cirrhosis and icterus present. The heart is sometimes enlarged, with a marked diminution in the thickness of the walls. The most characteristic lesion in ducks is an enlarged and blackened spleen.

Prevention.—Such measures as may be designed for the successful prevention of malaria in ducks and turkeys must take into consideration the following: (1) Rearing of birds in areas free from blackflies; (2) regular examination of blood smears of adults and young birds for the detection of carriers and the subsequent removal of these birds from the flocks; (3) raising of birds in confinement in houses screened against blackflies.

Treatment.—At present, no drug or drugs can be recommended for the treatment of birds suffering from leucocytozoon disease.

PIGEON MALARIA

Cause.—A protozoan parasite (*Haemoproteus columbae*) which lives in the blood of pigeons, invading the red blood corpuscles, is the cause of pigeon malaria.

Spread of the disease.—Pigeon malaria is spread by the pigeon fly (*Pseudolynchia maura*) the latter being necessary for the transmission of the parasite from one bird to another. The fly in biting takes in the parasites with the blood of the bird; the parasites multiply and develop within the insect's body and are then introduced into a bird by the bite of the fly.

Symptoms.—The destruction of the red cells by the parasites may cause anemia, a condition in which the blood becomes less red, this in turn lowering the vitality of the birds. Aside from this there are no marked symptoms.

Prevention.—Prevention consists in the destruction of pigeon flies. The Bureau of Entomology and Plant Quarantine recommends a thorough cleaning of the pigeon nests at intervals not to exceed 25 days, using a light spray of kerosene extract of pyrethrum in the interior of buildings, and one of the following procedures: Dusting the squabs and pigeons with fresh pyrethrum powder, derris powder, or tobacco powder containing about 6 percent of nicotine; dipping them with either an aqueous extract of pyrethrum with soap or derris extract with soap and water; or using the kerosene extract of pyrethrum spray on the birds.

WORM PARASITES AND THE DISEASES CAUSED BY THEM

Flukes

Flukes are small, flat worms, more or less resembling a leaf in shape. Their life histories always involve at least one intermediate host and sometimes two. There are two different kinds of flukes which have been found to cause disease in poultry in the United States and, although they are as yet rare in occurrence, they should be kept in mind as of possible importance in the future.

FLUKES CAUSING INJURY TO THE EGG-FORMING ORGANS

Parasite and the damage produced by it.—One species (*Prosthomonimus macrorchis*) reddish in color and about a quarter of an inch long, occurs in chickens in Michigan, Wisconsin, and Minnesota. Such flukes usually occur in the cloacal region, but they may invade the egg ducts and ovaries, causing serious injury to those organs. The symptoms shown by the fowls are dullness, loss of weight, and pallor; egg production is greatly decreased. In Europe, closely related parasites cause serious losses among chickens, ducks, and geese. The fluke occurs always near lakes or marshy places, such an environment being essential in its life history. It may occur in eggs laid by infected hens.

Life history of parasite.—The life history of this parasite involves snails and also dragonflies. The young worm, which hatches from the

fluke egg, develops partially in the snail to a form of different appearance; then, leaving the snail as a tailed form, it swims around and is drawn into the body of the young stage of the dragonfly, which lives in the water during its early life; in the insect the parasite forms a cyst; and, when the young or adult dragonfly is eaten by the chicken the worm develops to its adult form, from which the fluke eggs pass and begin the cycle again.

The parasite has been found in wild ducks and has been produced experimentally in crows and English sparrows; it probably may be spread by them to domestic fowls.

Prevention.—Repeated doses of carbon tetrachloride, from 1.5 to 1.7 cubic centimeters of the drug, given in liquid cereal, are reported as a successful treatment for this parasite. To prevent chickens from becoming infected in an area in which the parasite occurs, the fowls should be prevented from eating dragonflies. Chickens probably capture the flies when the latter are still cold and inert in the early morning, and keeping fowls confined to their houses until the air has warmed would probably help to keep down infection. Otherwise, fowls should be fenced away from lake shores and other wet places.

THE CYSTIC FLUKE IN THE SKIN

Another fluke (*Collyriclum faba*) has been found in cysts in the skin of chickens and turkeys in considerable numbers in Minnesota. In addition to injuring the general health of the fowl, the parasites produce blisters in the skin, the disfigurement reducing the market value of the fowl.

The parasite occurs also in the English sparrow and is probably spread by that bird. The life history is unknown.

Tapeworms

Description of parasite.—Tapeworms, or cestodes, are flattened worms made up of numerous divisions or segments, following a head region by which the tapeworm is attached to the intestinal wall. The tapeworm grows at the neck region, just behind the head, so that the segments farthest from the head are the oldest ones. When the tapeworm is fully developed, the oldest segments are filled with eggs and are spoken of as ripe or gravid segments; it is these segments which break off from the remainder of the worm and are passed in the droppings.

At least 10 different species of tapeworms are found in the United States in chickens, 9 or possibly 10 in turkeys, and several other species in the other domestic birds, such as ducks, geese, pigeons, and guinea fowls. The tapeworms vary much in size (fig. 21), some being so small that they are seen or found only with difficulty, whereas others are several inches in length.

Method of spread of tapeworms.—The life histories of tapeworms of poultry, so far as they have been definitely ascertained, indicate that these tapeworms must pass part of their lives in an intermediate host (fig. 22). This host is some small form of animal life which is eaten by poultry, either accidentally with feed or water, or actually as one of the items of feed. In the case of some of the tapeworms of poultry the nature of the intermediate host is as yet unknown,

but in other cases it has been definitely ascertained that dung beetles, ground beetles, meal beetles, ants, the housefly, snails, slugs, and earthworms serve as hosts for various chicken tapeworms; grasshoppers serve as hosts for one of the turkey tapeworms.

Damage done by tapeworms.—One of the larger tapeworms (*Railletina echinobothrida*) found in chickens produces in the intestine, especially in the lowest third of its length, numerous protuberances or nodules, which closely resemble the nodules caused by tuberculosis. If tapeworms are attached by the head to the inner surface of the intestine at the site of the nodule, such a condition may be ascribed to the worms. If tuberculosis is also present, there will probably be lesions in the liver.

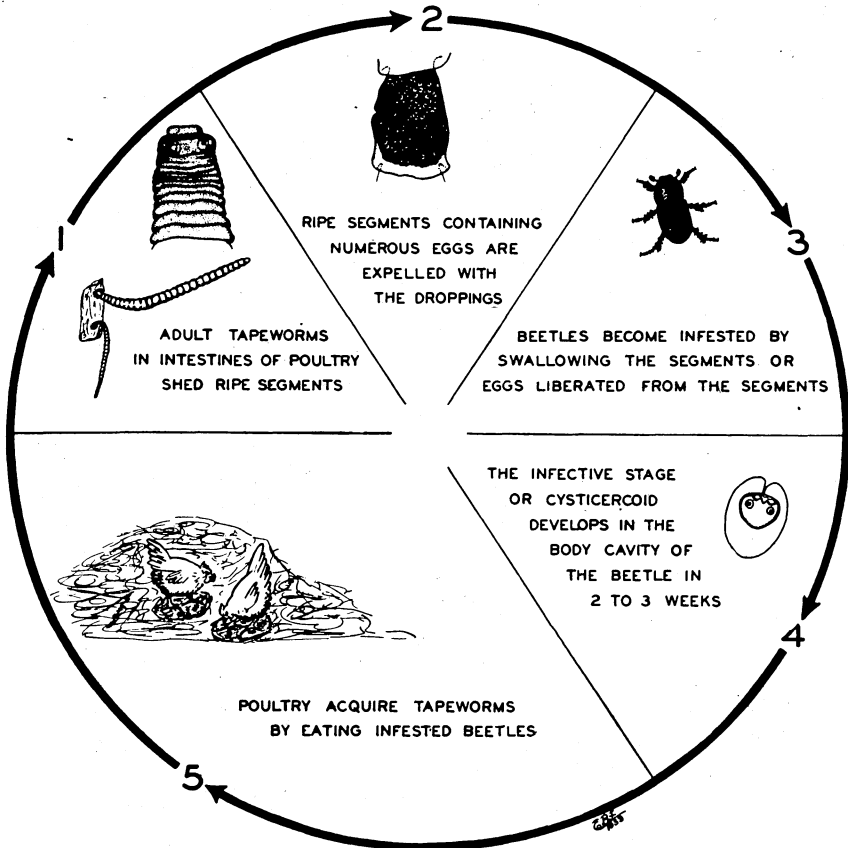


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FIGURE 21.—Seven different species of tapeworms found in chickens.
Natural size.

In the case of other tapeworms, however, the injury to the intestinal wall is not so marked. Loss of weight, loss of appetite, a general condition of droopiness or unthriftiness, intestinal catarrh, and diarrhea are the conditions most frequently found associated with the presence of tapeworms. Young fowls are most seriously affected. Occasionally, lameness and paralysis have been associated with heavy infestations with certain tapeworms. If these conditions are caused by tapeworms, the removal of the worms will clear up the condition, but the same conditions may be caused by other things, and the finding of tapeworms associated with these conditions does not prove that there is a connection between them.

Treatment.—There is no satisfactory drug for the removal of poultry tapeworms. Kamala was at one time considered an effective drug for use against poultry tapeworms, but a large amount of subsequent research has shown that kamala usually exerts only a “shearing” effect, removing the tapeworm strobilae or chains of segments but leaving practically all of the many tapeworm heads. These heads produce new chains of segments, and tapeworm-egg production is renewed in 2 or 3 weeks.



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FIGURE 22.—Life history of a poultry tapeworm, *Raillietina cesticillus*.

The heads of some species burrow deeply, reaching points deep in the mucous lining of the intestines, or beyond this to the muscular layer, or even to the serous coat on the outside of the intestine. No drug has yet been shown to be capable of reaching and killing these deeply buried heads. The only visible damage done by these tapeworms is that caused by the heads setting up inflammation and killing the surrounding tissues to which they are attached.

Prevention.—To prevent the spread of tapeworm disease, the droppings of the fowls should be disposed of in such a way that the known intermediate hosts of the parasite, such as beetles, ants, flies, slugs, snails, and earthworms, are kept from eating the eggs or seg-

ments of tapeworms passed in the droppings of infested fowls; and poultry should be prevented from eating these intermediate hosts which may be carrying larval stages of tapeworms. Prompt removal of droppings, keeping the yards and houses free of trash, boards, boxes, and other unnecessary objects, and the filling in or liming of damp places near feed and water vessels, which places may serve as hiding or breeding places for the intermediate hosts, are valuable preventive measures. The plowing up of pens and seeding them to short-growing vegetation, rather than leaving them in a weedy, fallow condition, helps to reduce the number of ground beetles.

In some places poultrymen have resorted to raising chickens in confinement, under screen, and on raised floors, in order to prevent their becoming infested with tapeworms. Certain of the beetles, however, which are known to serve as intermediate hosts, are considerably smaller even than houseflies, so that the mesh of the screening must be fine enough to keep out such small insects, to be thoroughly satisfactory.

In order that poultry droppings may not be wasted but may be used for manure, without danger of spreading worm infection, it is recommended that the droppings be stored for awhile, as previously described.

Roundworms

EYE WORM OF POULTRY

The parasite (*Oxyuris mansonii*), known as Manson's eye worm, is known to have been present in Florida for many years and has spread to Louisiana. It occurs in chickens, turkeys, and peafowls, and can develop in various wild birds. The parasite is found under the nictitating membrane—that is, the transparent membrane which passes over the eyeball of the fowl in the act of winking. The worms are slender and colorless and are about three-fourths of an inch long; they can often be detected by a firm pressing of the tear sac at the inner corner of the eye, when they will wiggle out over the eyeball.

Symptoms and damage produced by parasite.—Affected fowls wink the eye continuously and frequently attempt to rub the head on the feathers of the wing, or to scratch at the eye with the foot. The eyesight is not good. There is puffiness around the eye and a discharge from the eye and from the opening of the nostril. There is often a severe inflammation which may result in blindness; at times the entire eyeball is destroyed.

Life history of parasite.—This roundworm has an indirect life history, and its intermediate host has been shown by workers of the Florida Agricultural Experiment Station and elsewhere to be a cockroach (*Pycnoscelus surinamensis*). The cockroaches are found beneath boards and trash and in the vegetation at the edges of the fences; they feed on whatever food material is present, including the droppings of the fowls. From the droppings the cockroaches obtain the eggs or newly hatched larvae of the roundworms, the eggs having been washed down the tear ducts from the eye of the fowl and having then been swallowed and passed in the droppings. The young roundworm develops in the body of the cockroach and when the roach is eaten by a fowl the worm is freed in the bird's crop. It passes up the esophagus to the mouth and then through the tear ducts to the eye.

The cockroach which spreads the parasite in this manner in Florida and Louisiana also occurs in Texas, and in certain places in the North it has been found in greenhouses. There is danger, therefore, that the eye worm may spread to States other than Florida and Louisiana. By the feeding of cockroaches containing the young stages of the worms, the eye worm has been experimentally developed in ducks, bobolinks, a blackbird, a pigeon, a loggerhead shrike, and a blue jay; such birds as these must, therefore, be considered possible carriers of the roundworm in areas in which it is found in poultry.

Prevention.—The removal from the chicken yard and houses, and from the area around the yards, of all trash, boards, boxes, and other unnecessary objects, which may serve as hiding places of cockroaches, is probably the most important control measure. Roaches, which come from the outside into a clean yard, free from objects which may serve as hiding places for them, are likely to be eaten promptly by the chickens before the roaches have a chance to become infected by eating the chicken droppings. Such uninfected roaches will not cause worm infestation. Hiding places enable the roaches to become infested and to infect the chicken which subsequently captures them. The daily collection of droppings and their removal to a place where cockroaches cannot get at them is a measure of value. Affected birds should either be treated and cured or killed and destroyed.

GAPEWORMS⁹

A roundworm that produces unmistakable symptoms of disease is the gapeworm (*Syngamus trachea*). This parasite occurs in turkeys, chickens, and guinea fowls. Chickens rarely become infected with

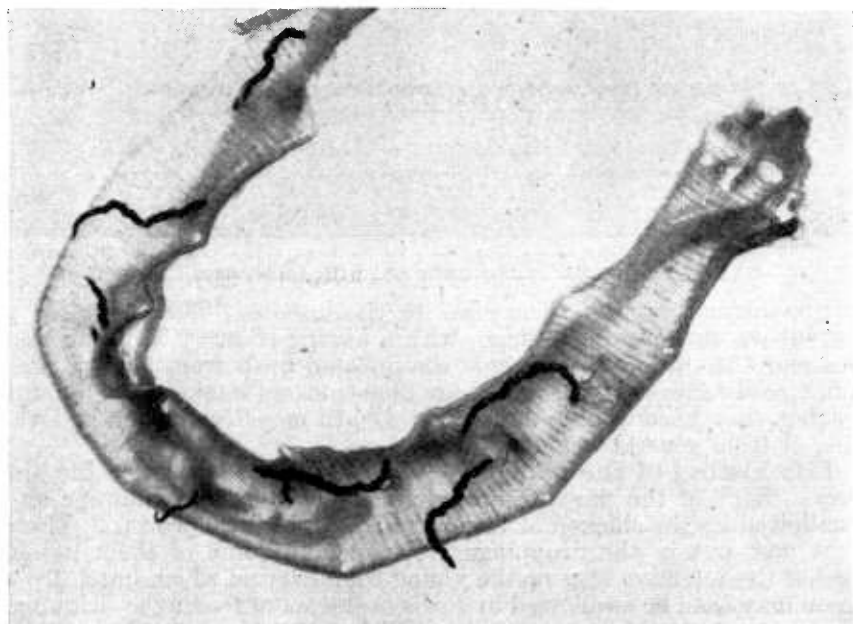


FIGURE 23.—Gapeworms attached to windpipe of young turkey.

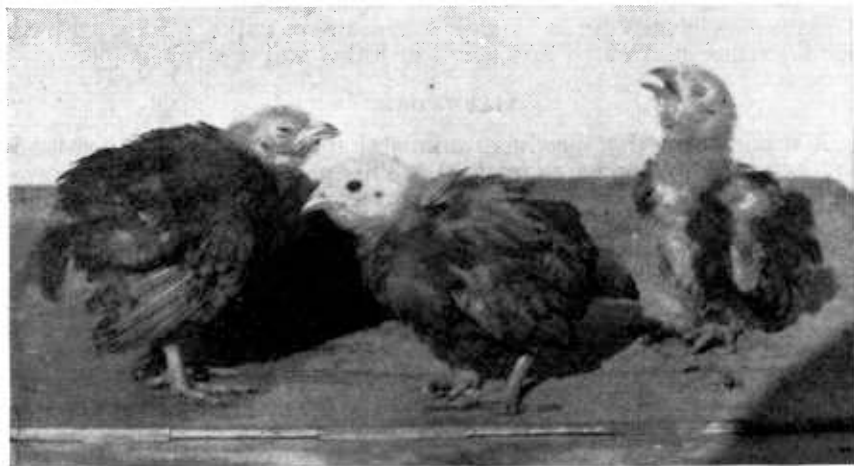
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⁹ For additional information on gapeworms see Leaflet 207, Controlling Gapeworms in Poultry.

gapeworms after they are 8 to 10 weeks of age, but turkeys and guinea fowls are susceptible throughout life. Chickens that become infested with gapeworms when very young may, in the absence of reinfection, retain the infestation for 4 to 5 months. As a rule, however, the worms are lost within a few weeks. Guinea fowls are susceptible to gapeworm infestation at any time during their life but usually lose their infestations in 3 to 4 months. In the absence of reinfection, turkeys may carry gapeworms for as long as 7 to 8 months and are probably one of the chief factors in the spread of gapeworm disease to chicks. Young poults as well as chicks may suffer severely from gapeworm infestation. The death rate among poults and chicks from gapeworm infestation is usually high.

Gapeworms are attached to the wall of the windpipe or trachea, on its inner surface (fig. 23). The male and female worms are joined together so that the two worms form a Y.

Symptoms of damage produced by parasite.—The worms clog the windpipe of infested birds, and because of an insufficient supply of air young chicks and poults that have gapeworms in their windpipes will open their beaks and gape (fig. 24); this behavior has given rise



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FIGURE 24.—Chicks affected with gapeworms.

to the name "gapes," as applied to the disease. There is often a convulsive shaking of the head, with a hissing cough. This continuous effort to obtain air prevents the infested birds from feeding; this and also the fact that the worms are bloodsuckers weaken the chickens so that they become thin and pale. Death may result from suffocation or from general weakness.

Life history of the parasite.—This parasite has a direct life history. Eggs of the parasite are coughed up from the windpipe and swallowed by the chicken or turkey which harbors the worms. These eggs pass out in the droppings, develop, and some of them hatch. Either the infective eggs or the young roundworms which hatch from them may then be swallowed by fowls in the act of feeding or drinking. Within a week the young worms will have reached the lungs, and from there they work their way up into the windpipe and may be fully developed within another week or 10 days.

Earthworms may play an important part in the spread of gapes. The infective eggs or the young gapeworms which have hatched in the soil from the eggs in the fowls' droppings may be eaten by earthworms; they burrow into the body muscles of the earthworm and may remain alive for considerable periods. The earthworm in these cases is not a necessary intermediate host of the parasite; it is merely a mechanical carrier or reservoir, protecting the young gapeworms from conditions such as drought and high and low temperatures, conditions which would otherwise kill the young parasites. Earthworms may thus carry the young gapeworms over from one warm season to another.

Another important factor in the spread of gapes is the fact that turkeys and guinea fowls may carry gapeworms throughout their whole life and thus may serve as sources of infection for chicks and young turkeys.

Prevention.—Raising young turkeys and chicks entirely separate from older turkeys and guinea fowls and on areas not recently used by turkeys is the most important preventive measure. If gapeworm disease has been present in the vicinity, dry, sandy soil should be selected for young turkeys and chicks to run on, as such soil is unfavorable to earthworms and for the development of gapeworm eggs and larvae. Young turkeys and chicks should be shut up until the dew has dried off in the morning, when most of the earthworms that have come to the surface will have disappeared.

Treatment.—Various medicinal treatments have been advocated, but none has proved as efficacious, in controlled tests, as barium antimonyl tartrate. Critical tests of this compound inhaled as a dust proved safe and efficacious for the removal of gapeworms from young chicks, turkey poults and adult turkeys. For treatment, the infected birds are placed in a closed container or box and exposed to the powder for 15 to 20 minutes. The size of the dose is determined by the cubic capacity of the container. One ounce of barium antimonyl tartrate is sufficient for a box having a capacity of 8 cubic feet. The box should be deep enough to allow a space of at least 6 inches above the heads of the birds when standing erect. In the beginning, one-third of the total dose is blown into the box by means of a dust gun through an opening at the top. The box, if of a convenient size, is then tilted slowly from one side to the other several times. Tilting causes the birds to stir around in the box, thereby aiding in redispersing any powder that may have settled on the feathers or the floor of the box, and forcing the birds to breathe more heavily and more frequently. This affords a better opportunity for the powder to reach the worms that may be located in the lower part of the windpipe. In the case of mature birds, when the treatment box is likely to be too heavy to tilt, a small electric fan may be placed on the floor of the box to keep the powder agitated. Five minutes after the introduction of the first one-third of the powder, the second one-third is introduced, and the tilting or the use of the fan is repeated. The remaining powder is introduced 10 to 15 minutes after the beginning of the treatment, and the box is again tilted or the fan used. The birds are released 5 to 10 minutes after the last of the powder has been blown into the box.

Mechanical removal, although a slow, difficult, and rather dangerous procedure, may be accomplished by the insertion of a loop of horsehair down the windpipe and the rotation of the loop in such manner as to dislodge the worms from the wall and entangle them in the hair, which is then withdrawn. A small quill feather, which is stripped of all its web except a small tuft at the end, may also be used in place of the hair; a little kerosene or oil of turpentine put on the feather will aid in loosening the worms and later will cause the bird to sneeze or cough and thus help to bring up the worms. Wire extractors made by commercial firms are used in the same manner.

CROP WORMS

Roundworms may occur in the crop and occasionally also in the undilated esophagus of chickens and turkeys. They are sewed into the walls and have the appearance of a wavy, white thread. The worms move around inside the wall and form burrows or tunnels.

One of these roundworms (*Gongylonema ingluvicola*) is comparatively rare, and is not known to injure the health of the fowl aside from slight local damage to the wall of the crop. This roundworm has an indirect

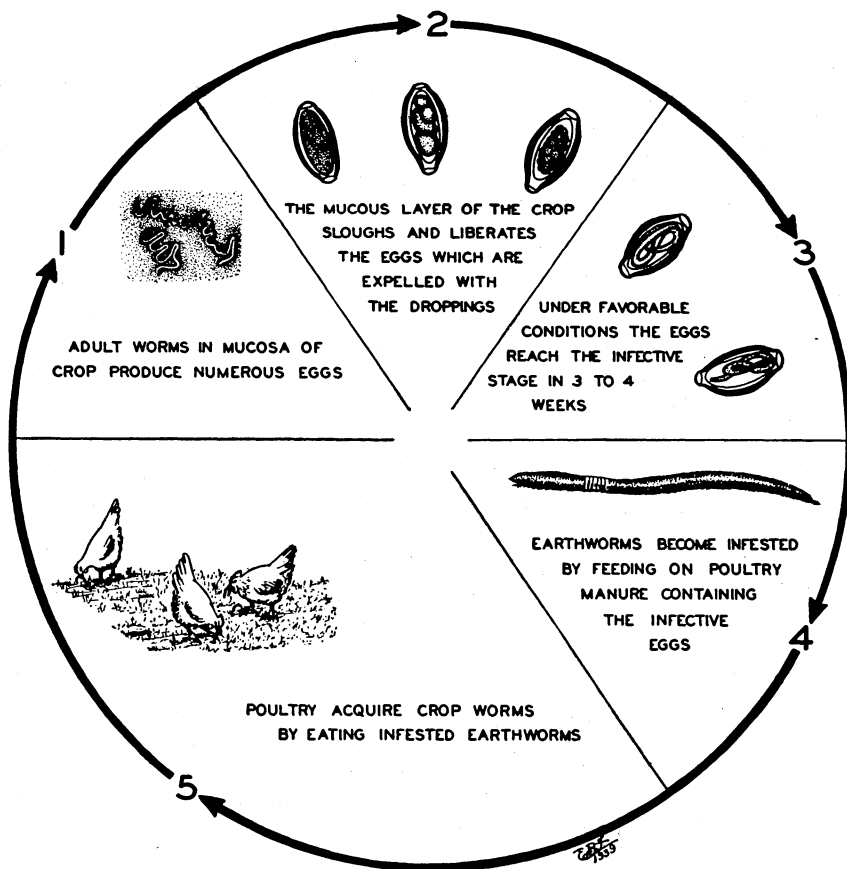
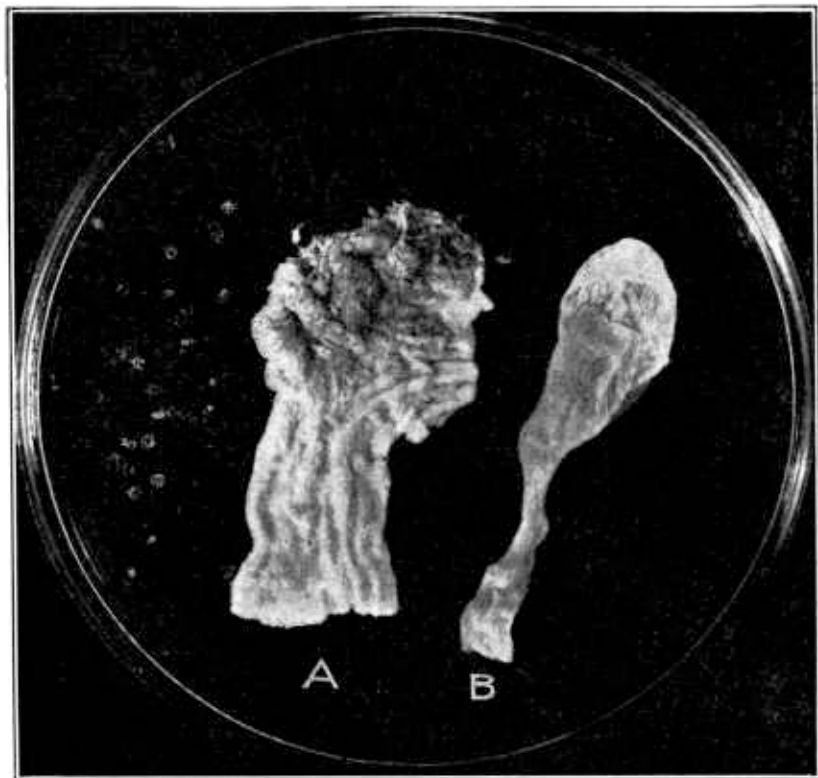


FIGURE 25.—Life history of the poultry crop worm, *Capillaria annulata*.

life history; there is evidence that cockroaches and dung beetles may be the intermediate hosts.

Another crop worm (*Capillaria annulata*) (fig. 25) appears to be of much more common occurrence. In severe cases these roundworms may be present in large numbers and may greatly damage the walls of the crop and the undilated esophagus (fig. 26). They interfere with digestion, and the fowls become progressively weaker and finally may die from the effects of the parasite. Recent evidence indicates that earthworms serve as the intermediate host of this crop worm.



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FIGURE 26.—A, A crop heavily parasitized by the crop worm (*Capillaria annulata*); B, a normal crop. Note on the extreme left the threadlike worms which caused the injury.

On the other hand, in the case of a closely related species (*C. contorta*) which occurs in domestic ducks in Europe and in turkeys, gallinaceous game birds, and wild ducks in the United States, direct experimental transmission from one bird to another has been accomplished. The eggs which pass out in the droppings develop to a stage which will infect the fowl swallowing them in contaminated feed or water.

Prevention.—General sanitary measures such as described on page 42 are advised.

Treatment.—No medicinal treatment has yet been developed. Worms which have burrowed into the crop are more or less protected from the action of drugs.

STOMACH WORMS

In the two stomachs of domestic birds, that is, in the proventriculus or glandular stomach and in the gizzard or muscular stomach, several different kinds of roundworms may be found.

The Tetramere of Chickens

The parasite (*Tetrameres americana*) shows very striking differences from most other roundworms. The usual slender, elongated form of roundworms is lost in the case of the female tetramere (fig. 27). While young, these parasites enter the glands of the stomach and as they develop to adults the large number of eggs which form within the body causes it to swell until it is practically globular in shape; also, its color changes to bright red. These parasites may be present in adult fowls without any apparent injury to the health of the fowl. In young chicks, however, they interfere with the proper digestion of food, so that general weakness and diarrhea, and even death, may result.



FIGURE 27.—A tetramere from the glandular stomach of a chicken. Enlarged about four times.

Life history.—The tetramere has an indirect life history and the intermediate hosts have been found to be grasshoppers and cockroaches.

Prevention.—Raising young chicks in such a way that they cannot feed on grasshoppers or cockroaches which may have had access to the droppings of older, infected chickens, and disposing of droppings so that the worm eggs in them are destroyed or that insects cannot get at the droppings, are the most important preventive measures.

Treatment.—No medicinal treatment is known.

The Spiral Stomach Worm

A short white roundworm (*Dispharynx spiralis*) which is curved or even twisted in a spiral, is found occasionally in the glandular stomachs of chickens, turkeys, and pigeons, as well as in gallinaceous game birds, in this country, and if present in considerable numbers may seriously affect the health of the bird. The more evident symptoms are droopiness and loss of weight, in spite of the fact that the birds have a ravenous appetite even up to the time of death. In pigeons the eye has been said to lose its color when the birds are suffering from the effects of this stomach worm. The stomach may be considerably enlarged and the glands of its walls may be partly or almost completely destroyed.

Life history.—This roundworm has an indirect life history, and sowbugs, or pillbugs, have been found to be the intermediate hosts.

Prevention.—Measures which will eradicate sowbugs from the premises, so that the birds cannot eat them, are of great importance.

Keeping the birds in dry, light quarters and the removal of unnecessary objects under which the sowbugs may hide are of value in this connection. The proper disposal of droppings, either to destroy worm eggs or keep them from all intermediate hosts, is important.

Treatment.—No medicinal treatment is known.

Gizzard Worm of Chickens and Turkeys

A slender white gizzard worm (*Cheilosporura hamulosa*) about one-half to three-fourths of an inch long, has been the cause of deaths of chickens in this country, and has also been found in turkeys. It passes through the horny lining of the gizzard, leaving small, round holes with raw, raised edges, and burrows into the muscular wall, producing tunnels in the wall or causing the formation of wartlike growths on its surface. Eggs of the parasite pass out of the holes and mix with the gizzard contents, eventually being discharged by the bird in its droppings. The wall of the gizzard may be so badly damaged by these worms that the digestion of food is interfered with and the health of the fowl consequently suffers from it.

Life history.—This roundworm has an indirect life history and its intermediate hosts have been found to be grasshoppers, flour beetles, and sandhoppers.

Prevention.—Sanitary measures, such as frequent collection and proper disposal of droppings so that grasshoppers and other intermediate hosts may not feed on them and thus become infected with the early stages of the roundworm, and secondly, measures to prevent the fowls from eating grasshoppers, are advised. Confining fowls to runs which have been sown to a short, thick, green vegetation, such as grass, rather than allowing them to range in long, dry vegetation which is favorable to grasshoppers, helps to reduce the number of these insects eaten by the fowls.

Treatment.—No satisfactory treatment is known.

Gizzard Worm of Domestic Geese and Ducks

In domestic geese and ducks a small slender roundworm (*Amidostomum anseris*) sometimes reddish in color from blood which it has swallowed, may be found burrowing in the horny lining of the gizzard; it does not invade the wall to so great an extent as does the gizzard worm of chickens and turkeys but causes more damage to the surface. There is considerable loss of blood by the bird, and the gizzard lining shows roughened areas stained brown from blood. The parasite may produce poisons which also weaken the bird. Numerous deaths may occur in flocks in which these parasites are present in large numbers.

Life history.—This roundworm has a direct life history. The eggs pass out in the droppings, young roundworms hatch from them, and, after being taken in by the birds in the act of eating or drinking, the worms develop to adults in the gizzard. This parasite has been transmitted experimentally from the domestic goose to the domestic duck in this manner.

Prevention.—Sanitary measures which prevent the contamination of feed and water with the droppings of infected fowls are of value.

Treatment.—No satisfactory treatment is known.

INTESTINAL ROUNDWORMS

Large Roundworm of the Intestine

The large roundworm or ascarid (*Ascaridia galli*), found commonly in chickens and less commonly in domestic ducks, geese, and turkeys, occurs in the small intestine and attains a length of from 1 to 4½ inches when fully grown (fig. 28). These worms may be present in such numbers as to block the intestines. Large numbers of the young worms may kill chicks in from 10 to 12 days. The parasites stunt the growth of the chick and prevent proper bone development, so that weakness results (fig. 30). Young chicks are most seriously affected by this roundworm. If the chick does not become infected until after it is 3 months old, the parasites do less damage to it. Grown fowls which harbor this parasite may be unthrifty and their egg production low.

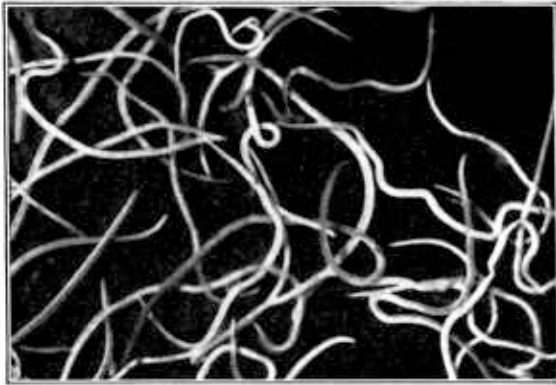
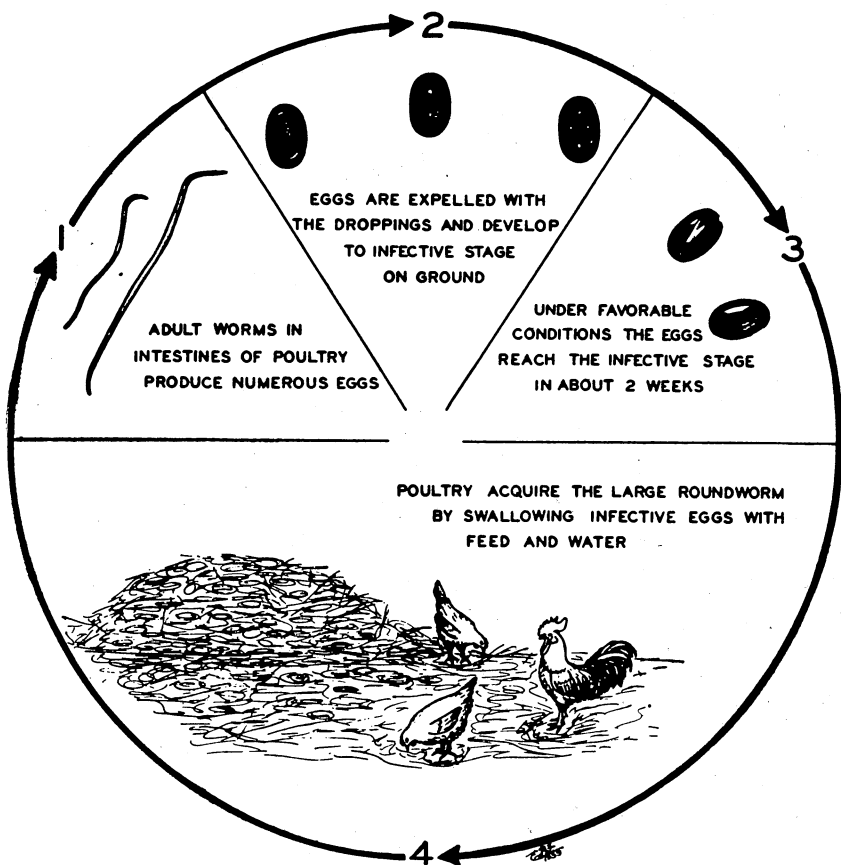


FIGURE 28.—Roundworms (*Ascaridia galli*) from the small intestine of a chicken. (Courtesy J. E. Ackert.)

The adult worms occasionally wander up the oviduct and are trapped in the hen's egg as it forms.

Life history.—The life history of this parasite is direct (fig. 29). The eggs of the parasite pass out onto the soil in the droppings of the fowl and the young stage of the worm develops within them in a period of about 15 to 20 days under favorable conditions. The young worm hatches from the egg when the latter is swallowed by a fowl. The young worms may burrow into the inner surface of the wall of the intestine, causing damage to the glands, for a period extending from about the tenth to the twentieth day after the egg is swallowed. Then the worms return to the interior of the intestine to develop into adults in about 2 months.

The eggs of the parasite are thick-shelled; they are resistant to cold but more easily killed by heat. In Kansas, the high temperature of summer has been found to kill all the eggs of this parasite on the surface of the soil and to a depth of 6 inches in unshaded places, but in shaded spots the eggs survived.



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FIGURE 29.—Life history of poultry roundworm, *Ascaridia galli*.

Prevention.—General sanitary measures should be adopted to prevent the worm eggs from developing in the soil and later being swallowed by the fowls. Rotation of runs has been found valuable. Special protection of chicks until they are 3 months of age, by raising them away from older chickens or areas ranged by such chickens, will prevent the greatest injury. A nutritious diet, rich in vitamins, has been found to be helpful in building up the resistance of the chick to this parasite.

Treatment.—The quickest and most effective treatment for the removal of the large roundworm consists in the individual dosing of each bird with carbon tetrachloride or the closely related drug, tetrachlorethylene, using a 1-cubic centimeter dose for adult birds; for young chickens, however, the dose must be reduced and given with caution. From evidence available, it is safe to treat young chickens at 2 months of age with tetrachlorethylene, which is the safer of the two drugs. The drug is most easily given in gelatin capsules, although it may be introduced directly into the crop through a soft rubber tube passed down the esophagus. Care must be taken that the drug does not get into the lungs, as in that case it may be quickly fatal.

A number of mixtures containing nicotine sulfate and a special fuller's earth known as Lloyd's alkaloidal reagent have been tested by workers of the California Agricultural Experiment Station. The treatment which proved to be the most satisfactory consists in the administration, to each bird, of a No. 2 capsule containing 0.35 to 0.4 gram of a mixture of 7.92 grams of 40-percent nicotine solution and 16 grams of Lloyd's alkaloidal reagent, which is a selected fuller's earth.

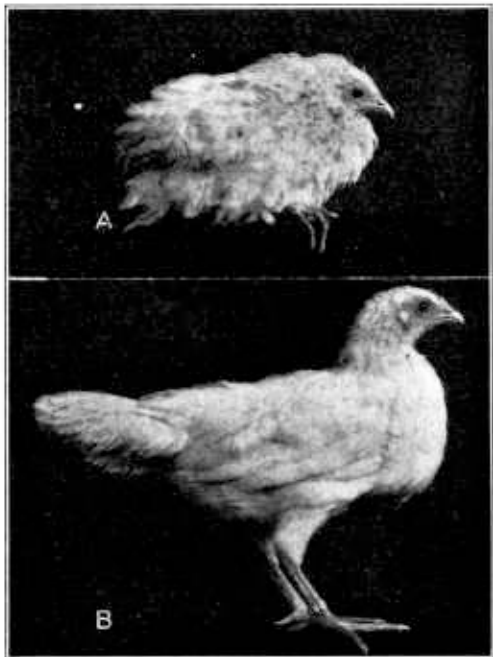


FIGURE 30.—A, Chicken suffering from large roundworms of the intestines, unable to recover from parasitism; B, control from same hatch, aged nearly 4 months. (After Ackert and Herrick.)

For mass treatment, rather than individual treatment, the California Agricultural Experiment Station recommends the following:

Add to the mash 2 percent by weight of tobacco dust containing at least 1.5 percent of nicotine, and feed this mixture to the flock for a period of 3 or 4 weeks. Treatment may be repeated at 3-week intervals as often as necessary.

If a single-dose treatment is desired for the removal of the large roundworm, the California station

recommends the use of one teaspoon of oil of chenopodium, thoroughly mixed with a moist mash, for each lot of 12 birds.

Large Roundworm of Pigeons

In the intestines of pigeons may be found a large roundworm which closely resembles that found in chickens, but it is a different species (*Ascaridia columbae*). This parasite may be present in large numbers, as many as 500 having been collected from 1 pigeon. The worms are sometimes found to have wandered into the stomachs and even up into the esophagus. The life history is similar to that of the large roundworm of chickens (fig. 29), and preventive measures would be similar in the two cases, with modifications to meet the different conditions under which pigeons are raised.

Treatment.—Carbon tetrachloride in repeated doses of from 1 to 2 cubic centimeters, given in liquid cereal or in liquid paraffin, has been reported to be satisfactory for the removal of this parasite. The pigeons may occasionally regurgitate the drug.

Common Cecum Worm, or Heterakid, of Poultry

The common cecum worm of poultry is also known as the heterakid (*Heterakis gallinae*); it occurs in the ceca, or blind guts, of chickens,

turkeys, guinea fowls, and domestic ducks and geese. This worm attains a length of from three-tenths to one-half inch. The worms are sometimes present in enormous numbers and may cause a serious inflammation of the ceca, especially in young chicks. As already noted, they are apparently involved in the transmission of blackhead in the presence of infective blackhead material.

Life history.—The life history of this roundworm is direct, the eggs developing in the soil in a period of from 7 to 12 days under favorable conditions. They are very resistant to freezing and to drying. The young worm hatches from the egg when it is swallowed by a fowl. The young worms invade the wall of the ceca for a short period, and may do considerable damage at this stage; later they return to the interior of the ceca and develop to adults in about 24 days after entering the fowl's body.

Earthworms may be a factor in spreading cecum worms and other worms; the eggs of the roundworms may be eaten by the earthworms and later reach fowls by being passed in the casts of the earthworms and thus infecting otherwise uninfected soil, or by the earthworms being eaten by the fowls.

Prevention.—As in the case of the large roundworm, general sanitary measures, rotation of yards, and special protection of young chicks are of value in preventing infestations with this parasite.

Treatment.—The removal of cecal worms by means of drugs is very difficult. Tobacco dust has been reported to be of some value, but only when fed over a long period of time. Investigations at the State College of Washington indicate that phenothiazine is an effective remedy for the removal of cecal worms.

Under experimental conditions, single doses of 0.5 gram per bird given either in gelatin capsules or in ground feed was reported to be efficacious.

No significant toxic manifestations following the administration of this drug to chickens have been reported. As much as 25 grams have been given in one dose without harmful results.

Another treatment consists in the use of rectal injections of oil of chenopodium in a bland oil, such as cottonseed oil. The dose is 0.1 cubic centimeter of oil of chenopodium in 5 cubic centimeters of cottonseed oil for a bird weighing 1½ pounds. Probably double this dose would be effective for a bird weighing 3 pounds or more. This mixture may be made up at the rate of one teaspoon of oil of chenopodium in 6 fluid ounces of cottonseed oil and given at the rate of one-third of an ounce to birds weighing 3 pounds or more, a proportionately smaller dose being used for smaller birds. The two ingredients should be thoroughly mixed and given with a hard-rubber enema syringe. It is as easy to give this treatment by rectum as it is to give a treatment by mouth. The tip of the syringe should be inserted into the rectum and the mixture injected slowly.

Single doses of drugs by mouth are relatively ineffective. The drugs commonly fail to enter the ceca, and the occasional entry is too uncertain to make these treatments reliable.

Intestinal Strongyle of Pigeons

In pigeons a serious disease may be caused by the delicate, slender roundworm known as the pigeon strongyle (*Ornithostrongylus quad-*

riradiatus). This parasite occurs in the small intestines of pigeons and some wild birds, chiefly the mourning dove. Birds heavily infested with this parasite become droopy, the feathers are ruffled, and the neck is retracted. The birds remain squatted on the ground and seldom move; when disturbed, they attempt to move but frequently tip forward on the breast and head. Food is taken sparingly and is frequently regurgitated, along with bile-stained fluid. Infested birds drink an excessive amount of water. There is a pronounced greenish diarrhea, and the birds lose weight rapidly. Death is preceded by prostration and difficult, rapid breathing.

Life history of the parasite.—The life history of this worm is direct. The eggs of the parasite pass outside with the droppings and, under favorable climatic conditions, hatch within 19 hours. Three days more are required for the larvae to reach the infective stage. When the infective larvae are swallowed by a pigeon or other susceptible host, they mature in the small intestine, and the females begin to deposit eggs in 5 or 6 days. The intestines of fatally infested birds are markedly hemorrhagic and have a green mucoid content, with masses of sloughed epithelium.

Prevention.—Air drying and direct sunlight are destructive to the eggs and larvae of this parasite. Therefore, it is essential that pigeon lofts be located on soil which has good drainage and is exposed to the direct sunlight. Drinking troughs and baths should be exposed to the direct sun and so arranged that water will not be splashed into the pen.

Treatment.—A treatment which has been reported as effective in expelling these worms consists in giving each pigeon three doses, each of which contains five centigrams (0.05 gram) of thymol. These doses should be given on alternate days and the third dose followed by a 1-cubic centimeter capsule of castor oil.

Pigeon Capillariid

The threadworm (*Capillaria columbae*) occurs in the small intestines of pigeons and chickens and also occasionally in turkeys. The worms are slender and colorless, usually about one-half inch long, and very difficult to see unless present in large numbers. Heavily infested birds lose weight, become emaciated, and sometimes die. In fatal cases and in severe advanced cases of infestation the intestines show extensive destruction of the mucosa, frequently with complete sloughing of the mucous membrane.

Life history of the parasite.—The life history of this parasite is direct. The eggs pass out in the feces. Under favorable conditions, young worms develop within the eggs in about a week. These eggs are now infective to other birds. The young worms escape from the eggs only after being ingested by a susceptible host. In the small intestine the young worms penetrate rather deeply into the intestinal mucosa and remain there until nearly mature, when they migrate to a position nearer the lumen of the intestine.

Prevention.—Prevention consists in giving the proper attention to general sanitation and the selection of well-drained areas for permanent pens and lofts.

Treatment.—There is at present no satisfactory treatment for the removal of these worms.

Other Roundworms of the Intestines

There are several different species of hairworms, or capillarids (*Capillaria* spp., in addition to *Capillaria columbae*), which occur in the small intestine and ceca of domestic poultry, all kinds of domestic birds being known to harbor such worms at times. The worms are very slender and colorless, usually from one-half to three-fourths of an inch long, and are found with difficulty unless present in large numbers. They may seriously affect the health of the fowls. Carbon tetrachloride given in a 1-cubic centimeter dose, and repeated about 7 days later, has been effective in removing some kinds of capillarids. The life history, so far as known, is direct, and general sanitary measures should be adopted to prevent reinfestation.

In chickens an extremely small roundworm, the chicken strongyloides (*Strongyloides avium*) has been found in the ceca; in young chicks especially, it may seriously affect the health. The walls of the ceca may be greatly thickened, and a bloody diarrhea may be present. If the chicks survive this acute stage, they may show no bad effects from the parasite, even though it is present, when the chickens are fully grown. The life history of this parasite is direct, but, unlike the direct life histories of other roundworms of poultry, this one includes stages in which the worms develop in the soil to adult males and females, which give rise to young. No treatment has yet been developed for removing this parasite. Special protection of young chicks and general sanitary measures are of value in preventing the spread of the parasite.

LICE

There are at least seven different species of lice occurring on domestic chickens, while still other forms occur on turkeys, ducks, and guinea fowls. As different species of lice are usually confined to different parts of the body and feathers, they are commonly referred to as head lice, wing lice, body lice, shaft lice, and fluff lice, although the distinction is not very exact, since the various species intermingle to some extent.

Lice on Chickens

The two most important lice on chickens are the head louse (*Lipurus heterographus*), and the body louse (*Menacanthus stramineus*). The head louse (fig. 31) is most injurious to young chicks. It occurs on the head at the base of the feathers or the down; it passes readily from one chicken to another, and from the hen to her chicks. It is important to treat the hen for lice before the hatch comes off. Treatment, as given below, should be applied to the head. The body louse is most injurious to grown fowls but occasionally affects young

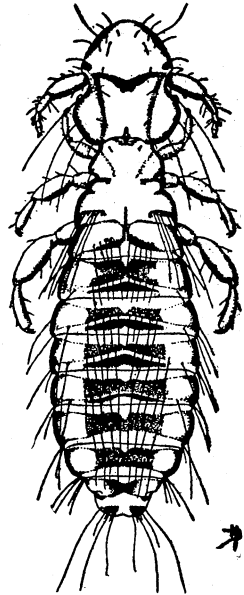


FIGURE 31.—The head louse, male, top view. Greatly enlarged.

chicks. It causes irritation to the skin, with at times the formation of scabs or blood clots. It is found directly on the skin, the most favored site being just below the vent, but head, neck, legs, and body may show the presence of these lice.

The shaft louse, the wing louse, and three other less common species are not so serious a menace to chickens.

Lice on Turkeys

Four species of lice are found on turkeys; two of these are species which also occur on chickens, whereas the other two are restricted to the turkey. The common body louse of chickens may cause considerable irritation to both young and grown turkeys; the shaft louse of chickens may be present, without evident bad effect. The two species which are found on turkeys only, the large louse (*Goniodes meleagridis*) and the slender turkey louse (*Lipeurus gallipavonis*) may be markedly injurious to poults and may cause severe annoyance to adults birds.

Lice on Ducks and Geese

Young ducks which are hatched by hens may suffer from the head louse of chickens. There are also at least three species of lice which are restricted to ducks and geese, but they are seldom present in sufficient numbers to cause noticeable annoyance.

Lice on Pigeons

There are two species of lice, different from those found on other domestic birds, which cause considerable annoyance both to old birds and to partially feathered squabs.

Lice Powders and Their Application

Experiments conducted by the Bureau of Entomology and Plant Quarantine have shown that a very satisfactory way of eliminating lice from poultry is to treat each fowl separately with sodium fluoride.¹⁰ If applied to all fowls as directed, one treatment is sufficient to kill all lice and their eggs. Commercial sodium fluoride may be purchased at most drug stores at from 30 to 60 cents a pound and may be applied either by the so-called pinch method, or by means of a duster made by punching small nail holes in the bottom of a can having a tight-fitting cover, or by dipping. If the pinch method is used, the bird is held on a table while sodium fluoride is applied next to the skin under the feathers, as follows: One pinch on the head, one on the neck, two on the back, one on the breast, one below the vent, one on the tail, one on each thigh, and one on the under side of each wing. The feathers should be ruffled to allow the powder to get next to the skin. If the bird is held in a large shallow pan, the small quantity of powder which falls off will be saved. If the powder is dusted on by means of a shaker the quantity of sodium fluoride used may be reduced by using three parts of road dust or flour to one part of the chemical. This method requires the services of a second person to hold and turn the fowl.

¹⁰ For further information on the control of lice and mites see Farmers' Bulletin 801, Mites and Lice on Poultry.

When considerable numbers of birds are to be treated the sodium fluoride should be used in the form of a dip, a rounded tablespoonful (1 ounce) of commercial sodium fluoride being used to each gallon of water. The birds should be held by the wings and plunged into a tub filled with the solution, the head being left out, while the feathers are ruffled with the hand to allow the solution to penetrate to the skin. The head is then ducked once or twice and the bird held for a few seconds to drain, and then released. Dipping is just as effective as the other methods and is quicker and more economical of material. Dipping should be done only on warm, sunny days.

To sick fowls or to very young chickens or turkeys, sodium fluoride should be applied only by the pinch method, and especially in the case of young birds it should be used cautiously, in very small pinches.

One pound of sodium fluoride will treat 100 birds by the pinch method. Figuring a person's time at 40 cents an hour and the drug at 40 cents a pound, it has been estimated that it costs about \$2 to treat 100 fowls. The cost of treatment by dipping is about one-half of this amount, and the irritating effect of the powder on the operator is avoided.

Another good lice powder is flowers of sulfur, which should be applied with a duster. Although sulfur is considerably cheaper than sodium fluoride, it is less effective against lice and hence must be applied more liberally, so that its use is in reality more expensive than that of sodium fluoride. Many other powders, some of which contain pyrethrum (insect powder), are commonly used, but they have no advantage over sodium fluoride.

Dust baths containing a mixture of tobacco dust or other insecticide and ordinary road dust are often recommended to destroy lice. While it is a good plan to let the birds dust themselves when they wish, no method which allows the bird to treat itself for lice can be expected to eradicate them all, since fowls cannot get the dusting powder on all parts of the body where lice are, and many lousy birds will not use the dust baths.

A simple procedure, which is effective in controlling lice but will not eradicate them, consists in the application of undiluted 40-percent solution of nicotine sulfate to the top surface of the roosts by means of a paint brush. This is done a short time (from 15 to 20 minutes) before the fowls go to roost. The fumes of the nicotine kill the lice during the first, second, and third nights after application. The head lice, naturally, are least affected. As some of the lice are not killed and the eggs are not destroyed, it is necessary to repeat the treatment frequently.

It is possible and practicable to keep a flock of poultry absolutely free from lice and mites, and this should be the aim of everyone who is endeavoring to establish a successful poultry flock.

MITES

Common Red Mite

While there are many kinds of mites affecting poultry, there are three which are of special importance to poultry raisers, the best known being the common chicken mite or red mite (*Dermanyssus gallinae*). In the Northern States this mite is dormant in winter, except in chicken houses which are heated, but in the South it breeds

and is active the year round, although it is always most abundant in summer. Unlike the other mites affecting poultry, this parasite, with few exceptions, is found on the birds only when it is feeding (fig. 32). It is nocturnal in habits, feeding at night and hiding during the day in the cracks of the roosts, in the nests, in the corners of the floor, or between boards. For this reason its presence often remains undetected until the chicken houses are badly infested and the poultry raiser seeks an explanation for the drooping condition and listlessness of his fowls.

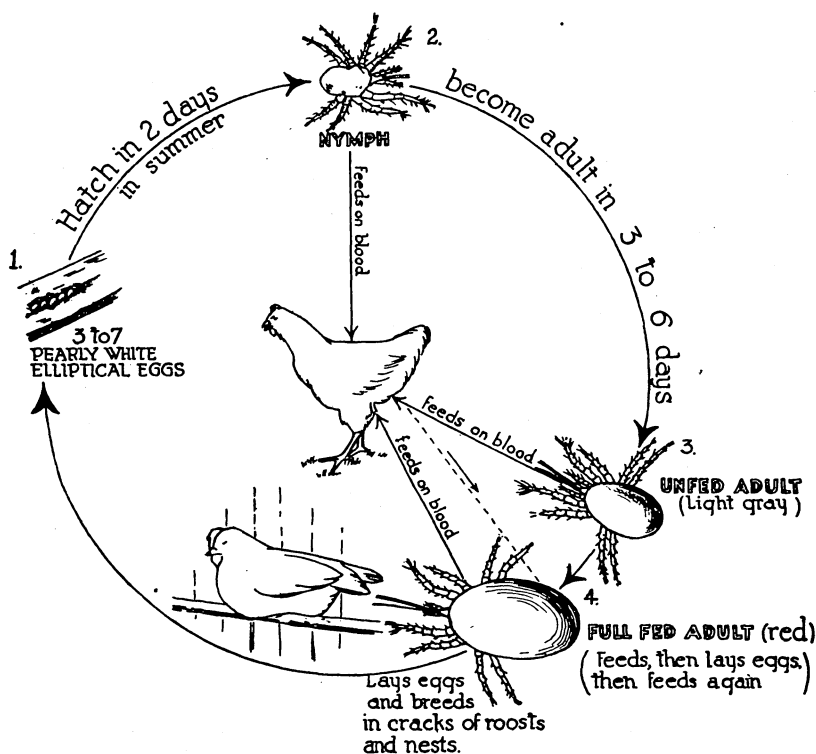


FIGURE 32.—Diagram showing the life habits of the common chicken mite.

Treatment.—To eradicate the pest a thorough cleaning of the chicken houses and spraying with a suitable insecticide having sufficient body is all that is necessary. All roosts, loose boards, and boxes should be removed and the insecticide applied in the form of a rather coarse spray, using a suitable pump. One of the best substances for the purpose is one of the carbolineums. As this is a little too heavy to spray well, it may be thinned with an equal quantity of kerosene, or the undiluted material may be applied with a brush to the roosts, roost supports, nest boxes, and other places where the mites are found. High-grade creosote also gives satisfactory results. Crude petroleum is somewhat less effective but is usually cheaper. It should be thinned by adding one part of kerosene to four parts of crude oil. Pure kerosene, kerosene emulsion, and carbolic acid, when brought in contact

with the mites, will kill them, but as they all lack sufficient body for persistence the spraying must be repeated several times, making the use of these materials impracticable. The coal-tar dips, used in a slightly stronger solution than recommended on the labels, will be effective if the application is repeated, and the germicidal properties are a desirable feature. Whatever preparation is used, the birds should be kept out of the houses until the fluid has thoroughly soaked into the wood.

Depluming Scabies

Fowls and pigeons are sometimes infected by an itch mite (*Cnemidocoptes gallinae*) which lives at the base of the feathers, causing an intense itching and producing a disease known as mange or depluming scabies. The irritation caused by the mites leads the fowls to pull out their feathers, and they often acquire the habit of feather pulling, attacking the plumage of other birds as well. If the stumps of the feathers are examined soon after the breaking of the quill, they will be found surrounded by scales and crusts, and the adjoining feathers when pulled out will be found similarly affected. In this way the condition can easily be distinguished from molting or the vice of feather pulling, which fowls sometimes acquire without apparent cause. The mites causing the disease are introduced into the poultry yard by affected fowls and spread rapidly from fowl to fowl, finally infesting nearly all in the flock. The disease usually begins in the spring, is most active in warm weather, and largely disappears in winter.

Treatment.—Complete control may be effected by dipping the entire flock in a tub of water containing 2 ounces of flowers of sulfur and one-half ounce of laundry soap to each gallon of water. If the fowls are also infested with lice, the two pests may be eliminated with a single treatment by dipping in this mixture, to which has been added three-fourths of an ounce of commercial sodium fluoride. As the depluming mite is well protected by the skin scales, it is necessary to soak the fowls thoroughly to destroy all the mites. As a soapy mixture of this kind completely wets the plumage, special care must be taken to do the dipping on a warm day when there is little wind. When the infestation is limited to a few birds, or when for other reasons it is not desired to treat the whole flock, the trouble may be held in check by applying to the affected parts an ointment made by thoroughly mixing one part of flowers of sulfur with four parts of vaseline or lard.

The Feather Mite

Infestations with the feather mite (*Liponyssus sylviarum*) have occurred in many flocks during the last few years; it is very injurious in the northern part of the United States. This mite closely resembles the common chicken mite, but has very different habits in that it breeds among the feathers. The eggs are deposited and hatch among the feathers where the young mites may complete their entire development without leaving the fowl. These mites are to be found in greatest numbers below the vent, about the tail, and sometimes on the neck. The feathers often have a dirty appearance from the presence of the mites, and the skin may be irritated and scabby from the bloodsucking habits of the parasites. The feather mite may first be detected on the hens' eggs, their presence can then be

definitely determined by finding groups of mites, their eggs, and excrement among the tail feathers of the chickens. These mites have been found in the nests of English sparrows near infested chicken houses.

Treatment.—Feather mites may be destroyed by dipping affected fowls in a tub containing a mixture of water, 1 gallon; flowers of sulfur, 2 ounces; and soap, 1 ounce.

The feathers should be thoroughly wet to the skin. The head should be submerged for an instant. During the dipping process the mixture should be stirred so as to keep the sulfur in suspension. Dipping should be done only on warm, sunny days, or in a heated building. If treatment is found to be necessary during the winter or early spring months, thorough dusting of the fowls with flowers of sulfur should take the place of dipping.

The nesting material should be removed and burned, and nest boxes, roosts, walls, and floor should be sprayed or painted with anthracene oil as recommended for use against the common chicken mite.

A simpler method than the one just mentioned, reported as satisfactory in some cases but not so successful in others, consists in painting the perches with a 40-percent nicotine sulfate solution shortly before the fowls go to roost, and dusting the nest with sulfur. Nests of English sparrows in the immediate vicinity of the poultry house should be destroyed.

Scaly Leg; Mange of the Leg

Another species of itch mite (*Cnemidocoptes mutans*) attacking chickens, turkeys, pheasants, and cage birds is the cause of a condition known as scaly leg. While this mite is usually confined to the legs, it may occasionally attack the comb and wattles. The disease occurs in most cases as a result of association with infested birds. It spreads slowly, and many individuals escape it entirely, although constantly exposed to it (fig. 33).



FIGURE 33.—Bird affected with scaly leg.

Symptoms.—The disease is easily recognized by the enlargement of the feet and legs and by their rough appearance. The parasite begins its attack in the clefts between the toes and gradually spreads forward and upward until the whole of the foot and the shank become affected. The two legs are usually attacked about the same time and to the same degree. At first there is only a slight roughening of the surface, but the continued

irritation by the mites causes a spongy or powdery formation beneath the scales, which raises them more and more until they are nearly perpendicular to the surface and are easily detached. In the

most severe cases the joints become inflamed, the birds are lame and scarcely able to walk, a joint or an entire toe may be lost, and the birds lose flesh and die.

Treatment.—The most effective treatment for scaly leg is to dip the feet and shanks of the infested birds in crude petroleum. This can be done most easily by putting the petroleum in a large bucket or tub. In dipping the feet, care should be taken not to get the oil on the upper part of the legs or on the feathers. If a large number of fowls are to be treated, it is best to do the work in the morning. This gives an opportunity for the oil to dry in and evaporate before the fowls go to roost. Another treatment which has its advocates but is more laborious is to wash the feet and legs with soap and warm water, removing all loose scales. Dry the legs and apply an ointment containing 2 percent of carbolic acid or 15 percent of fine sulfur, or a mixture of Peruvian balsam, 1 ounce, and alcohol, 3 ounces. When crude petroleum is not readily available, kerosene oil may be used as a dip for the feet. With the crude-oil treatment usually one application is sufficient, although in severe cases a second application 30 days later may be desirable. With the other remedies mentioned, a second treatment should be given 3 or 4 days after the first. To prevent the spread of the scaly-leg mites from fowl to fowl it is advisable to apply anthracene oil or crude petroleum to the roosts.

Other Mites

Several other species of mites infest poultry. One species bores into the skin and is found in cysts lying on the under surface of the skin next to the muscles. This form is not known to do any serious injury. Still another species occurs in the air passages, liver, and lungs of chickens. Unless present in sufficient numbers to interfere with breathing, it is not a serious pest. Still other mites live among the feathers of the birds, sometimes causing an unsightly appearance of the feathers but apparently causing little injury to the birds themselves.

Chiggers or Harvest Mites

Chiggers, harvest mites, or "red bugs," *Trombidium alfredduges*, which so frequently annoy campers by the intense itching they produce, may also attack fowls. Young chickens and turkeys having a free range, especially if it includes lowlying lands, are the most likely to suffer from these parasites. The mites attach to the skin, causing an intense itching, and abscesses may be found where clusters of mites are feeding. These abscesses are sometimes a third of an inch in diameter, surrounded by an area of inflammation. The birds become droopy, refuse to eat, and may die from hunger and exhaustion.

Treatment.—If an abscess has not yet formed, the inflamed area may be treated with sulfur ointment, Peruvian balsam, or a mixture of one part of kerosene with three parts of lard. If suppuration has occurred the scab should be removed and the area washed with 4-percent carbolic acid solution. Frequent light dusting with flowers of sulfur will keep the chickens from becoming infested. In the Southern and Central States, where harvest mites are most numerous, it is often necessary to keep young chickens off the range in

summer. In these sections it is a good plan to hatch the chickens early in spring, so that when the warm weather comes, in which the mites are most abundant, the birds will be old enough to resist their attacks.

TICKS ¹¹

In some parts of the South, poultry are commonly infested with a species of tick known as the chicken tick or blue bug (*Argas miniatus*). This parasite when full-grown may be from one-fifth to nearly one-half inch long and is a powerful blood sucker. In its adult stage of development it has feeding habits similar to the much smaller red mite, in that it feeds only at night and spends the days hiding in cracks in the roosts or walls. Pigeons are occasionally attacked by a similar tick, and both species have been known to inflict painful bites on persons coming in contact with infested birds. These ticks, on account of their relatively large size as compared with mites, can do a great deal of damage in a poultry or pigeon house, and birds attacked by them are likely to succumb from loss of blood or a type of paralysis. Moreover, in the case of the chicken tick, it is known that in some countries this parasite may itself be parasitized by minute organisms (*Spirochaeta gallinae*), which are injected into the blood of the fowl which it attacks, causing a severe and usually fatal fever. In this way the tick acts as a carrier of the disease organism much as the mosquito by its bites carries the organism causing malaria in man.

The first stage of the chicken tick's development is passed on the body, the seed tick leaving the birds when it has become engorged; thereafter the adult tick attacks chickens only at night, after they have gone to roost.

Treatment.—Chicken ticks are very persistent, and ordinary insecticides have little effect on them. All loose boards and boxes which may provide hiding places for the ticks should be removed and anthracene oil or crude petroleum applied as recommended for the treatment of red mites. After the general spraying, it is usually necessary to apply anthracene oil to the roosts, roost supports, and nests several times at intervals of 3 or 4 weeks.

A simple and inexpensive way of protecting chickens from the attacks of ticks and to facilitate treatment is to provide readily demountable roosts supported from the floor and not touching the walls. These should be painted occasionally with anthracene oil or petroleum. Nests should be located away from roosting places. If constructed of metal, the nests can be quickly rid of ticks from time to time by burning out the straw.

Metal houses have been found to be effective in dealing with the ticks, as even without special attention they remain practically tick-free, and if necessary they can be disinfected easily by a fire of straw, paper, or other light material, after the removal of the roosts. Metal houses, however, are usually more expensive than wooden ones and are hot in summer and cold in winter. If they are used in summer, the fowls should be provided with shade outside the house.

When ticks have once been eradicated from the premises no chickens should be added to the flock until they have been quarantined

¹¹ For additional details see Farmers' Bulletin 1070, The Fowl Tick and How Premises May Be Freed From It.

for 10 days in temporary coops. The coops should be destroyed after use or thoroughly treated with anthracene oil.

FLEAS¹²

In the Southern and Southwestern States, poultry are frequently infested by a species of flea known as the sticktight flea (*Echidnophaga gallinacea*) so-called from its habit of remaining attached to one place. This form (fig. 34) also attacks dogs, cats, and some wild birds and animals. On poultry, the fleas are usually found in clusters on the comb, wattles, and around the eye; on dogs they are found on the ears. Young fowls when heavily infested often die quickly. Older birds, while more resistant have been known to succumb to heavy infestations and even mild infestations reduce egg laying and retard growth.

Treatment.—As a preliminary step in the treatment of fleas, all dogs and cats should be kept away from the chickens and should never be allowed to lie on the ground in the chicken yards. As rats frequently harbor large numbers of these fleas and may therefore keep up the infestation, they should be destroyed by trapping, not only on account of the fleas they may carry but because they are themselves a serious pest to poultry. Sticktight fleas breed in the dust on the floors of hen houses and on the soil under houses and outbuildings. Hence, especial attention must be given to the treatment of the breeding places as well as to the infested fowls. The combs and wattles of the birds may be anointed with carbonated petroleum or sulfur ointment. Great care should be taken, however, not to get any of the ointment in the birds' eyes, as it may produce blindness. The hen houses and yards should be thoroughly cleaned and sprayed with creosote oil. As the fleas breed freely in the dust beneath buildings, it is advisable to exclude poultry and animals from such places.



FIGURE 34.—The sticktight flea, adult female. Much enlarged.

THE BEDBUG AND CLOSELY RELATED BUGS

The common bedbug (*Cimex lectularius*) and one of its close relatives, the Mexican chicken bug (*Haematosiphon inodora*) as well as the European pigeon bug (*C. columbarius*) and the swallow bug (*Oeciarus vicarius*) may attack domestic birds and may become serious pests. The bugs live in the nests or about roosting places, hiding in the cracks during the day and coming out at night to suck the blood of the fowls. They especially annoy setting hens, sometimes causing them to desert their nests. Since bedbugs may gain entrance to houses and cause much annoyance to human beings, their control is doubly important.

Treatment.—These pests can usually be destroyed by the thorough spraying of all cracks of the poultry house with creosote oil or crude petroleum.¹³ Poultry houses should be built so as to eliminate, so far as possible, holes and cracks which offer protection to the bugs.

¹² For additional details in regard to chicken fleas, see Leaflet 152, How to Control Fleas.

¹³ For additional details in regard to the bedbug and its control, see Leaflet 146, Bedbugs.

BEETLE AND FLY LARVAE

There are several different kinds of beetle larvae which may occasionally attack domestic birds. Young pigeons especially suffer from such attacks. The larder beetle (*Dermestes lardarius*) and also the meal worm (*Tenebrio molitor*) have been known to kill squabs by eating away the skin at the vent and neck, thus producing serious sores; and larvae of one of the sexton or burying beetles (*Nicrophorus* sp.) may also attack these young birds. The adult of the meal worm, on the other hand, may greatly annoy setting hens, attacking their feet. In addition the screwworm (*Cochliomyia americana*) and larvae of the blowflies (*Lucilia* spp. and *Cochliomyia macellaria*) may be found on domestic birds, the eggs having been deposited by the fly in sores or in the natural openings of the bird's body.

THE PIGEON FLY

In recent years the pigeon fly (*Pseudolynchia maura*) has become a serious menace in many parts of the United States, especially in the Southern States. The flies annoy the pigeons and, when numerous their bites cause considerable loss of blood; in addition, they transmit the organisms which cause pigeon malaria. See page 56 for details in this connection and for control measures.

CAUTION

All disinfectants, whether used in dusts or solutions, are more or less poisonous and irritating to the eyes, skin, and respiratory passages. Persons applying these chemicals should be careful to avoid breathing or ingesting them. Eyes, nose, and mouth should be protected, particularly from the dusts. Goggles, gloves, and in some cases respirators should be worn.